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DEPARTMENT OF THE ARMY FIELD MANUAL

TACTICAL EMPLOYMENT OF RIOT CONTROL AGENT CS

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TACTICAL EMPLOYMENT OF RIOT CONTROL AGENT CS

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CHAPTER 1

INTRODUCTION

1–1. Purpose

This manual provides doctrinal guidance and, where appropriate, tactics and techniques for the employment of riot control agent CS.

1–2. Scope

This manual provides doctrinal guidance for the employment of CS munitions and weapon systems in tactical operations principally at brigade, division, and lower level in low- to mid-intensity conflict. It gives the status and a brief description of CS munitions now available for use. These munitions include standardized, developmental, limited production (LP), and ENSURE (expedited nonstandard urgent requirement for equipment) items. Target effects data, area coverage, or munitions expenditure is given for each item, if available.

1–3. Policy

Authorization for the use of riot control chemicals will be granted by the Secretary of Defense or the President, as appropriate for each theater of operations. Restrictions on the tactical use of such agents will be issued at the time of the authorization.

1–4. Changes and Comments

Users of this publication are encouraged to submit recommended changes and comments to improve the publication. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commanding Officer, U.S. Army Combat Developments Command Chemical-Biological-Radiological Agency, Fort McClellan, Alabama 36201.

CHAPTER 2

OPERATIONAL CONSIDERATIONS

2–1. General

a. Agent CS is used in combat operations to temporarily reduce the effectiveness of enemy personnel. Its major advantages in tactical operations are its greater area coverage and its ability to penetrate fortified positions. CS affects personnel primarily through the respiratory tract and by contact with the eyes. However, in a warm, humid atmosphere, CS collected on the skin and mixed with perspiration may become harassing.

b. Agent CS is concentration dependent. When individuals are subjected to relatively low initial concentrations, symptoms appear almost immediately. Ability to take evasive action or repel attackers is reduced within seconds in 50 percent or more of those target personnel exposed to the agent cloud. The first effects experienced are violent irritation of the eyes, nose, and respiratory tract; tears will flow and the eyes will close involuntarily. Prolonged exposure to high concentrations will result in severe chest pains, coughing, nausea, and vomiting. Nausea and vomiting will seldom be experienced from concentrations that can be achieved in the open. If the skin of exposed individuals is moist, agent CS can cause severe irritation. Effects will continue as long as target personnel are exposed to the agent. Affected persons will recover (except for skin irritation) within 15 minutes or less after being removed to fresh air.

2–2. Protection

a. The protective mask and ordinary field clothing will give protection against the effects of agent CS in normally expected field concentrations. Individuals handling and loading this agent in bulk powder form should also wear rubber gloves.

b. Pilots and crews of helicopters or fixed-wing aircraft will observe the following precautions:

(1) Masks for the entire crew must be available when carrying CS munitions either internally or externally.

(2) The pilot or copilot will remain masked as long as:

(*a*) CS drums armed with the XM925 fuze and burster system are on the aircraft.

(*b*) The helicopter is hovering within ground effect when carrying the XM28 dispenser system (brown bag).

(*c*) XM15 CS clusters are on the aircraft.

(3) When flying close to operational areas where CS is used, pilots should avoid flying through visible CS clouds. However, if the visible cloud cannot be avoided, one pilot *must* be masked; both pilots should be masked.

(4) When there is only one pilot in an aircraft that will be flying near an area where CS is used, the pilot must mask *before* takeoff.

2–3. Limitations

a. The effects of agent CS are temporary and the length of time the soldier is ineffective is short; therefore, operations must be planned so that exploitation is timed to occur immediately after target coverage has been achieved.

b. Agent CS does not circumvent the protective mask. However, any amount of agent inhaled before masking, or trapped in the mask when it is donned, continues to be effective and gives the impression that the mask is leaking. This impression, coupled with the effects of the dosage received before masking, frequently causes an individual to remove his mask prematurely and thus become subjected to an increased dosage.

c. Command and control may be difficult if troops must wear protective masks while operating in jungle terrain or while conducting night operations. Training and careful planning will reduce this limitation.

2–4. Available Forms of CS

CS munitions are filled with a pyrotechnic CS mixture or micropulverized (powdered) CS which is designated CS1 or CS2.

a. CS, in a pyrotechnic mixture, is used in burning-type munitions such as grenades, cartridges, projectiles, rockets, and canisters. Initial concentrations of CS disseminated by pyrotechnic means remain effective for only short periods of

time and must be replenished if the concentration is to be maintained in the target area.

b. CS1 is powdered CS blended with an aerogel which reduces agglomeration and increases the effectiveness of the agent. It is used in bursting-type grenades; in bulk agent dispersers such as 55-gallon drums, and bombs; and in the M3, M5, and M106 dispersers only if CS2 is not available. CS1 will remain effective on open terrain about 14 days. Rains will dissolve and physically remove the agent; high winds may dissipate it.

c. CS2 is powdered CS blended with silicone-treated aerogel. The silicone-treated aerogel serves not only to prevent agglomeration and increase flowability but also markedly increases resistance to water. These characteristics prolong the effectiveness of the agent in terrain restriction operations. CS2 settles and readily contaminates terrain, vegetation, personnel, and equipment. It floats on water. When CS2 is disturbed, it is reaerosolized to cause respiratory and eye effects. CS2 will remain effective on open terrain for about 30 days. Rains will not dissolve the agent but may physically wash it away from the site of deposit and high winds will dissipate the agent.

2–5. Downwind Effect

The downwind effect of CS is called "downwind effect" as contrasted with downwind hazard for toxic agents because it is actually only a nuisance. Friendly troops can easily be protected by the M17 or XM28 protective mask. CS operations should be coordinated with friendly units to avoid inadvertent or accidental exposure from the downwind drift.

CHAPTER 3

EMPLOYMENT OF CS IN TACTICAL OPERATIONS

3–1. General

a. When effectively integrated into the unit fire plan, CS munitions used in tactical operations will reduce friendly casualties. These munitions may be used to force unmasked troops from concealed or protected positions; to reduce their ability to maneuver or use their weapons; and to facilitate their capture.

b. CS munitions can be effectively used in all types of operations. Tactical uses can be divided into two broad categories: situations in which an airborne concentration is established quickly for direct effects on target personnel; and situations in which powdered CS is disseminated for residual effect to restrict the use of terrain and facilities.

3–2. CS Employed for Direct Target Effects

Agent CS employed in the direct-target-effects role is generally effective against troops that are not equipped with protective masks or that are poorly trained in the use of the mask. It will be effective against well-trained and well-equipped troops *if* an intolerable concentration can be established within about 15 seconds or less. Optimum effectiveness in this role can be attained only with a weapon system capable of: rapidly establishing a continuous, intolerable concentration of CS (up to the height of an average man) long enough to allow agent effects to be exploited; and producing a cloud extensive enough so that target troops cannot easily evade the effective concentration. CS can be used for direct target effects in the following tactical applications:

a. Attack targets containing enemy troops and civilians where minimum destruction of civilian structures is desired. Since CS munitions cause less physical damage than high explosive it can be used to route an unmasked enemy from villages and built-up areas and cause him to become disoriented and ineffective as a fighting force. (Pyrotechnic CS munitions may cause secondary fires.)

(1) The XM15 cluster and the E8 launcher can be used effectively to saturate villages in cordon and search operations.

(2) The XM651E1 cartridge, fired from the M79 grenade launcher, can be used to clear buildings, religious centers, shops, or any structure to which damage such as would be caused by HE munitions is not acceptable.

(3) The XM629 105mm cartridge and the XM630 4.2-inch cartridge can also be used in clearing villages if the cartridges are fired off-target, upwind so that the agent cloud will be carried over the target by the wind.

(4) Immediately after the village or built-up area has been saturated with CS, it should be thoroughly searched and all occupants interrogated because enemy troops will try to merge with noncombatants and later attempt to escape in the confusion.

(5) In planning an attack on an area believed to contain civilians, provision should be made for—

(*a*) Any medical attention that may be required;

(*b*) Decontamination of civilian structures and the areas immediately surrounding them; and

(*c*) Psychological operations (PSYOPS) to explain to civilians the reasons for using CS.

(6) Even though the effects of CS are usually only temporary, infants, the aged, and the sick could be more severely affected.

(7) Laundry detergent and water will adequately decontaminate structures. Contaminated earth can be decontaminated by removing a layer of earth or by covering with "clean" soil.

(8) A possible theme for PSYOPS would be to emphasize the short duration of discomfort and the small amount of damage caused by CS as compared to the results of HE munitions.

b. Rout enemy troops from bunkers, caves, buildings, foxholes, tunnels, and similar strong points. The E8 launcher, XM15 cluster, XM651E1 cartridge, and M7A3 CS grenade (in close quarters) can be effectively used to suppress fires or rout unprotected enemy from fortified positions. The E8 launcher can place an effective concentration of CS in caves and bunkers within its range to aid in neutralizing the enemy. In addition, the CS cloud may screen movements of

friendly troops attacking the bunker or cave. An E8 launcher fired directly into a tunnel entrance can force a dense CS cloud far down inside the tunnel. During airmobile operations, when enemy bunkers or other fortified positions near a landing zone (LZ) are not neutralized by preparation or suppressive fire, CS munitions can be effectively used to force unprotected enemy troops from these positions. This use of CS increases the possibility that friendly troops will land without casualties.

c. Suppress enemy fire. CS munitions can be employed in conjunction with tactical air and artillery strikes on suspected enemy base camps in a target softening role. Before an assault, CS munitions can be airdropped on enemy fortified positions. The XM99 FFAR, with its standoff capability, is the preferred munition for this operation. The XM15, which requires overflight of the target, is less desirable but can be used, if necessary. CS can be expected to remain effective for only 5 to 15 minutes in most cases. Friendly operations should be tailored to that time duration or additional CS coverage planned. It should be aggresively followed up by the manuever force with a good probability that this force will receive less aimed fire.

d. Break contact with the enemy. CS can be effectively used by small units to break contact during ambush. The CS confuses the enemy, screens the movement of friendly forces, and discourages pursuit.

(1) E8 launchers, mounted on vehicles, are effective for breaking contact and for breaking the perimeter of an enemy force which is surrounding a friendly unit; thus, providing the friendly unit an avenue of escape.

(2) XM15 clusters can be used by a reconnaissance patrol desiring to break contact with enemy elements tracking them; for example, the team marks its position with smoke and withdraws as the CS is delivered.

(3) CS grenades are effective, especially in jungle areas.

(4) XM651E1 cartridges can also be used by a patrol to break contact. While the XM651E1 is not particularly effective in the open, it does allow the CS to be projected at ranges in excess of those possible for handthrown grenades.

e. Support friendly troops when the enemy is too close to permit friendly troops to use HE munitions. If friendly troops are equipped with masks, CS artillery or mortar rounds can be fired into or near friendly positions so that the agent cloud will drift over the enemy position. The E8 launcher can be fired within the no-fire-zone which is established to protect friendly positions from friendly HE fires.

f. Defend base camps and fire bases. CS planned as an integral part of a base camp or unit defense plan, can effectively enhance the unit's defensive capabilities. It must be well-planned and coordinated to assure that it does not interfere with the defense plan. Normally, CS will be employed only on the downwind side of the perimeter; however, in a last ditch effort to disorganize a massive ground assault which will overrun the base camp or unit position, CS can be employed where necessary. In very-close-in CS fires or even CS fires on the friendly position, the requirement to mask may increase already serious command, control, and communications problems. The 4.2-inch CS mortar round can be fired at close range in preplanned defensive fires. The E8 launcher can be emplaced and fired electrically for close-in defense.

3–3. CS Employed for Residual Effect

CS employed for residual effect must be delivered in large quantities in a form that will produce an aerosol when disturbed even after several days exposure to the elements. CS2 is the preferred form of the agent for this application, with CS1 being used as a second choice. The munitions used to disseminate CS1 and CS2 in bulk form are designed to put the agent on or near the ground with minimum flashing (burning) and limited dispersion. In addition to the munitions described in this manual, improvised methods are also used. *Agent CS employed to restrict the use of terrain is not effective against troops equipped with masks, and will not serve as a barrier to a determined enemy without masks.* However, it may provide sufficient deterrent to cause the enemy to avoid the area or to delay his operations. Although a determined enemy may traverse a fairly large contaminated area he will not be able to occupy or carry on extensive operations without a mask or without some type of decontamination. CS2 has an immediate aerosol effect; however, if enemy personnel are not detected, airstrikes or artillery should not be placed on the contaminated area because the HE will disturb and reduce the effectiveness of the contamination. CS1 or CS2 can be used for residual effects in the following tactical applications:

a. Restrict use of terrain and facilities. Known or suspected enemy base camps, safe havens, and assembly areas can be contaminated with CS2 to

restrict their future use by the enemy without the need for continued occupation by friendly forces. Airborne sensors, agent reports, and reconnaissance patrols can detect enemy reuse of a contaminated area and thus alert friendly troops to the need for recontamination.

b. Restrict use of bunkers, caves, tunnels, and dug-in positions. The use of bunkers, caves, tunnels, and dug-in positions contaminated with CS2 may be restricted to the enemy for extended periods of time. The CS2 is impregnated into the structure by field expedient demolition techniques. This employment technique is particularly valuable where combat units find and attempt to quickly destroy bunkers and tunnels by demolition methods. Such destruction is usually not complete. CS2 added to the destruction charges will make enemy reconstruction efforts significantly more difficult and uncomfortable.

c. Harass and interdict enemy lines of communication, infiltration routes, and supply routes. If the enemy is highly motivated and takes the proper precautions, he can pass through areas contaminated with CS1 or CS2; however, his free use of contaminated sites such as fords, bridges, ferry sites, trails, valley passes, and jungle roads will be restricted. Contamination with BLU–52 bombs or CS drums can effectively harass and delay repair of a bridge or ferry site that has been damaged or destroyed in an attack with HE munitions.

3–4. Coordination and Planning

a. Fire support for CS operations must be carefully coordinated between the supporting unit and the supported unit. Staff responsibilities and planning of fire support for CS operations are the same as for other operations except that provision must be made for prompt exploitation because of the short duration of agent effects.

b. Staff officers who plan the fire support must have knowledge of the resources available and the priorities for their use, since fire support units having a CS delivery capability are the same units that deliver HE, smoke, and other fires. Utility helicopters used to deliver CS munitions also have other high priority missions. The staff officer must be familiar with response times and area coverage capabilities of the various systems supporting CS operations so that he can plan realistic responses.

c. The chemical officer advises the commander on the selection of CS munition, expected effects on target, and downwind effects.

d. There are certain limiting requirements that must be considered before the final decision is made to employ CS. These include both operational requirements and political and civilian considerations. They are:

(1) Unit mission.

(2) Length of time unit will operate in the area.

(3) Future plans for operations in the area.

(4) Proximity of strike zone to population centers.

(5) Effects of operations on pacification programs.

3–5. Munition Selection

a. Factors to be considered in the selection of the most suitable CS munition are:

(1) Desired effects (immediate or residual).

(2) Method of delivery.

(3) Terrain.

(4) Location of friendly troops (troop safety).

(5) Protection available to the enemy.

b. Representative tactical applications and some of the more appropriate munitions are cited in paragraphs 3–2 and 3–3. Descriptions and characteristics of available munitions are given in chapter 4 of this manual. Figure 3–1 summarizes the most frequent tactical applications and the CS munitions most suitable for use.

3–6. Weather, Terrain, and Vegetation

a. Weather.

(1) If a CS cloud is to be placed directly on an occupied area—

(*a*) A stable (inversion) atmospheric condition is most favorable. It occurs from sunset to sunrise when the windspeed is *less* than 8 knots and the sky is clear. Light, variable winds aid in achieving a uniform distribution of the agent cloud across the target area.

(*b*) A stable-to-neutral condition with windspeeds of less than 3 knots and little turbulence is also excellent. This condition is prevalent in dense rain forests and jungles.

(*c*) A neutral atmospheric condition is moderately favorable. It occurs during early morning and late evening; from sunset to sunrise when the windspeed is *greater* than 8 knots or when the sky is overcast; or at any time the windspeed is greater than 10 knots. With a low windspeed and smooth terrain, large areas may be covered with CS. From a tactical standpoint, it is an advantage to know that a neutral condition

CS MUNITIONS	TACTICAL APPLICATIONS							
	Attack mixed enemy and civilian targets	Rout enemy from fortified positions	Suppress enemy fire	Break contact	Recon by CS	Defend base camps and fire bases	Harass and interdict enemy lines of communication	Restrict enemy use of terrain or facilities
Grenades								
M7A3	X		X	X		X		
M25A2	X			X				
XM58	X		X	X				
XM54	X		X					
40mm Cartridges								
XM651E1		X	X	X	X			
XM674*		X	X	X	X			
Ground Launcher								
E8	X	X		X		X		
Dispersers**								
M3							X	X
M5							X	X
M106							X	X
Air Delivered								
XM15(E158)	X	X	X	X	X	X		
XM165(E159, CBU-19/A)	X	X	X		X			
XM99	X	X	X			X		
CBU-30/A		X	X					
XM925							X	X
XM28							X	X
BLU-52A/B							X	X
Mortar and Artillery								
XM630 (4.2-inch)		X	X			X		
XM629 (105mm)		X	X			X		

*Used only when the XM651E1 is not available (ref: para 4-3b).

**Used only when more efficient CS munitions are not available (ref: para 4-5).

Figure 3-1. CS munitions for principal tactical application.

will usually exist at dawn and at sunset. If the windspeed is not too high, a neutral condition may be best for military planning purposes because it occurs more frequently than stable or unstable conditions.

(*d*) An unstable (lapse) atmospheric condition, windspeeds above 10 knots, and heavy rains are the least favorable conditions. Unstable conditions occur in the daytime under clear skies when rising air currents are prevalent. High winds will dissipate the CS cloud. Light rain will not seriously degrade the effectiveness of most CS munitions, but heavy rain will wash the CS out of the air.

(2) Agent CS may be employed under any weather condition if operational requirements dictate. When employed under adverse weather conditions, munition expenditures may increase, off-target effects may be undesirable, and on-target effects may be degraded; but the requirement should be considered paramount.

b. Terrain. Terrain contour and surface cover influence the flow of agent clouds the same as they influence the flow of air. Agent clouds under favorable conditions tend to flow over low rolling terrain, down valleys, and settle in hollows, depressions, and on low ground. Local winds blow down valleys at night and up valleys during the day. An agent cloud released in a narrow valley subjected to a mountain breeze retains a high concentration of the agent as it flows down the valley. Hence, high dosages may be obtained in narrow valleys or depressions. High dosages are difficult to obtain on the crests or sides of ridges or hills. Rough ground tends to deflect a chemical cloud; ground covered with tall grass or brush retards flow; obstacles, such as buildings or trees, set up eddies that tend to break up the cloud and cause it to dissipate more rapidly. Open water or flat country, when a neutral or stable condition exists, promotes an even, steady cloud flow.

c. Vegetation. When munitions are dropped into wooded areas, the thickness and height of the foliage will determine the amount of CS that is effective and the amount that is lost in the treetops. A dense canopy tends to resist penetration of aerosol or vapor clouds from outside the canopy and to prevent escape of clouds established under the canopy. Clouds resulting from munitions released within woods or jungles are smaller and the concentrations are higher, sometimes as much as three times higher, than those of clouds released in the open. The concentration from ground release depends upon the density of undergrowth and trees.

CHAPTER 4

CS MUNITIONS FOR TACTICAL OPERATIONS

4–1. General

CS munitions can be employed by individuals or small units. They can be delivered by Army aircraft, by air support of other services, and by the 4.2-inch mortar and the 105mm howitzer. *Any time CS munitions are employed into the wind, friendly troops in the area should wear the protective mask.*

4–2. Grenades

Grenades are used to dispense CS into the atmosphere to cause the enemy to become temporarily ineffective without inflicting permanent physical harm. They can be used to rout the enemy from his position in buildings, small caves, foxholes, and bunkers; to reduce the effectiveness of enemy defensive measures; and to aid friendly troops in breaking contact.

Caution. **Burning-type grenades will cause fires if employed around flammable material.**

a. Grenade, Hand, Riot, CS, ABC–M7A3 (fig. 4–1).

(1) *Status.* Standard–A. Army, Air Force, Navy, Marine Corps.

(2) *Description.* The M7A3 is a cylindrical, burning-type grenade, filled with CS. It can be handthrown or launched from a rifle when fitted with the M2A1 grenade projection adapter. The M7A3 has a 2-second delay fuze and 15- to 35-second burning time. The range is 35 meters, if hand thrown; and 120 meters, if rifle launched. References: TM 9–1330–200 and FM 23–30.

(3) *Area coverage.* At a windspeed of 4 knots, the M7A3 grenade will produce an effective concentration over about 60 square meters in an elliptical pattern approximately 18 meters long by 4 meters maximum crosswind width. At higher windspeeds, the pattern will be longer and narrower.

b. Grenade, Hand, Riot, CS1, ABC–M25A2 (fig. 4–2).

(1) *Status.* Standard–A. Army, Navy.

(2) *Description.* The M25A2 is a spherical bursting-type grenade filled with CS1. This grenade is handthrown and is designed to minimize flying fragments. It has a 2-second delay fuze, can be thrown 40 meters, and has a 5-meter bursting radius. The M25A2 is primarily used in civilian disturbances but can be used in tactical operations if it is more readily available than other hand grenades. Since it is filled with CS1, it does leave residual contamination. Its primary advantage is that an effective concentration is produced instantaneously. References: TM 9–1330–200 and FM 23–30.

Figure 4–1. Grenade, hand, riot, CS, ABC–M7A3.

(3) *Area coverage.* One grenade—about 110 square meters. Effective downwind coverage—about 20 meters.

c. Grenade, Hand, Riot, Pocket, CS, XM58 (fig. 4–3).

(1) *Status.* ENSURE—LP, Army.

(2) *Description.* The XM58 is a small lightweight grenade, designed for pocket carry, filled with CS pyrotechnic mixture. The XM58 can be

Figure 4–2. Grenade, hand, riot, CS1, ABC–M25A2.

thrown 45 meters and has an 8- to 28-second burning time. The XM58 can be handthrown with more accuracy and for a greater distance than the M7A3. Reference: TM 3–1330–204–10

(3) *Area coverage.* Against bunkers and small dwellings in villages, one grenade should be sufficient. When used to break contact, several grenades may be required to produce the desired effect. Coverage is less than the M7A3.

d. Grenade, Hand, 8- to 12-Second Delay, CS, XM54 (fig. 4–4).

(1) *Status.* ENSURE, Army.

(2) *Description.* The XM54 consists of an M7A3 grenade modified to accept an 8- to 12-second delay fuze. This modification permits airdrop of the grenades from altitudes of 1,500 feet. The XM54, filled with CS pellets and a pyrotechnic mix, weighs about one pound. The grenade can be handdropped from low-performance aircraft or fired up to 120 meters from a rifle fitted with the M2A1 grenade projector adapter. When airdropped from an altitude of 1,500 feet, it begins to emit a cloud of CS at 100 to 50 feet above the terrain.

(3) *Area coverage.* At a windspeed of 4 knots, the XM54 grenade will produce an effective concentration over about 60 square meters in an elliptical pattern approximately 18 meters

Figure 4–3. Grenade, hand, riot, pocket, CS, XM58.

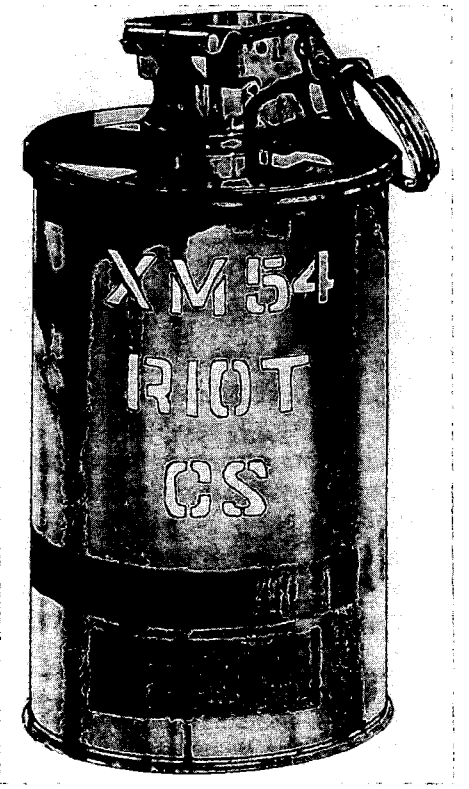


Figure 4–4. Grenade, hand, 8- to 12-second delay, CS, XM54.

long by 4 meters maximum crosswind width. At higher windspeeds, the pattern will be longer and narrower.

4–3. 40mm Cartridges

The cartridges described below are especially effective when fired into enclosed areas such as caves, bunkers, or houses.

a. Cartridge, 40mm: CS, MX651E1 (fig. 4–5).

(1) *Status.* LP, Army.

(2) *Description.* The XM651E1 is an aluminum cylinder, 11.3 cm long, filled with CS-pyrotechnic mix, and is equipped with a point-detonating fuze (XM581E1). The base of the cartridge is notched for touch identification at night. The cartridge is fired primarily from the M79 grenade launcher, but can also be fired from the XM203 grenade launcher attachment for the M16 rifle. It can be used against any target vulnerable to agent CS. Maximum accuracy is obtained at ranges up to 200 meters. Area targets may be engaged up to 400 meters. The projectiles will penetrate window glass or up to ¾-inch thick pine at 200 meters and release CS after penetration. Reference: TM 3–1310–243–10.

(3) *Area coverage.* Two cartridges, effectively placed, will incapacitate 95 percent of the personnel in an enclosure 15 x 30 feet within 60 seconds after functioning.

Note. The XM651E1 should be fired at the base of flimsy buildings so that the cartridge will not pass all the way through the building before it detonates.

b. Cartridge, 40mm: Riot Control CS, XM674 (fig. 4–6).

(1) *Status.* LP, Army.

(2) *Description.* The XM674, known as "Handy Andy," is an aluminum tube that contains a rubber projectile filled with CS pyrotechnic mixture. It can be fired from the M79 grenade launcher, from the AN–M8 pyrotechnic pistol, or by hand. The munition will function from 2 to 7 seconds *after* firing. Unreliable range and lack of precision make the XM674 a much less effective munition than the XM651E1. However, if the XM651E1 is not available, the XM674 *can* be used on targets similar to those attacked with the XM651E1. The XM674 has a range of approximately 70 meters. Reference: TM 3–1310–244–10.

(3) *Area coverage.* One munition—about 120 square meters.

4–4. Ground Launcher

Launcher and 35mm Cartridge: Tactical CS, 16-Tube, E8 (fig. 4–7).

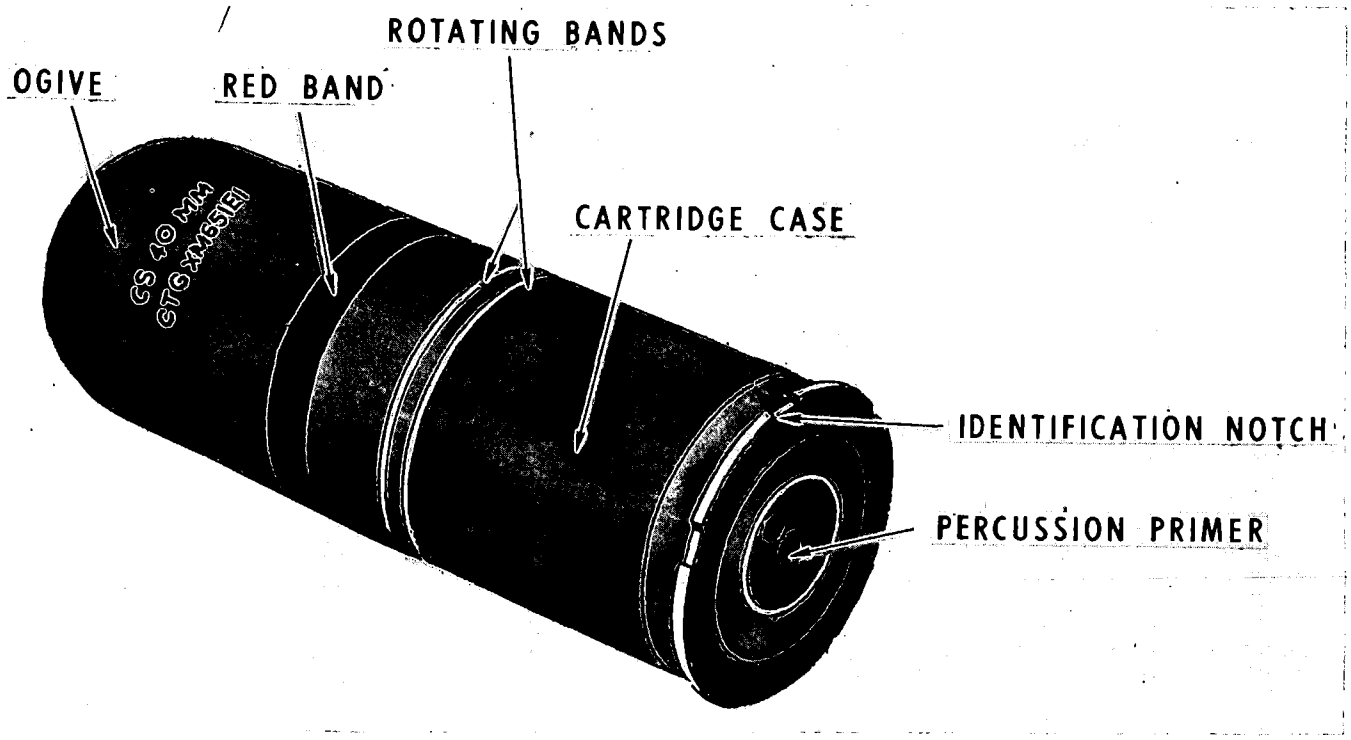


Figure 4–5. Cartridge, 40mm: CS, XM651E1.

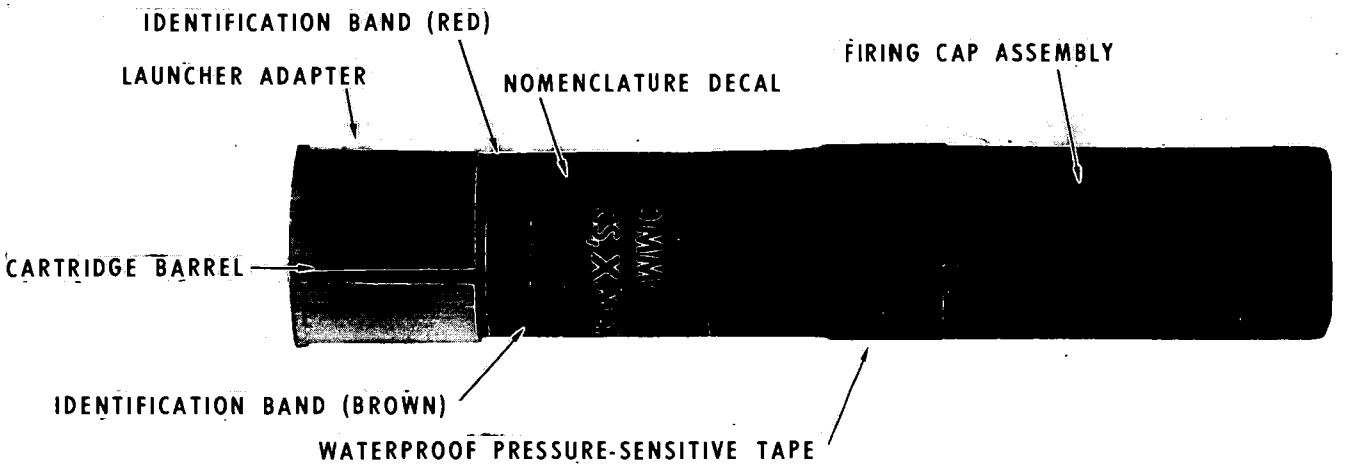


Figure 4–6. Cartridge, 40mm: riot control CS, XM674.

a. Status. LP for SEA (Southeast Asia), Army.

b. Description. The E8 launcher is a man-portable, ground-employed, expendable munition that can be fired either electrically or manually. The launcher may be emplaced, sighted, and fired by one man. It may be fired singly or in groups. The E8 consists of a launcher module and a firing platform with carrying harness and backpad attached. The launcher module has 16 tubes, each containing four E23, 35mm CS cartridges. The elliptical dispersion pattern of cartridges from the E8 launcher is relatively independent of meteorological conditions. However, the period of effective agent concentration on a target area is dependent upon existing meteorological conditions. (See para 3–6.) Reference: TB 3–1310–255–10.

c. Area Coverage. Two launchers will produce

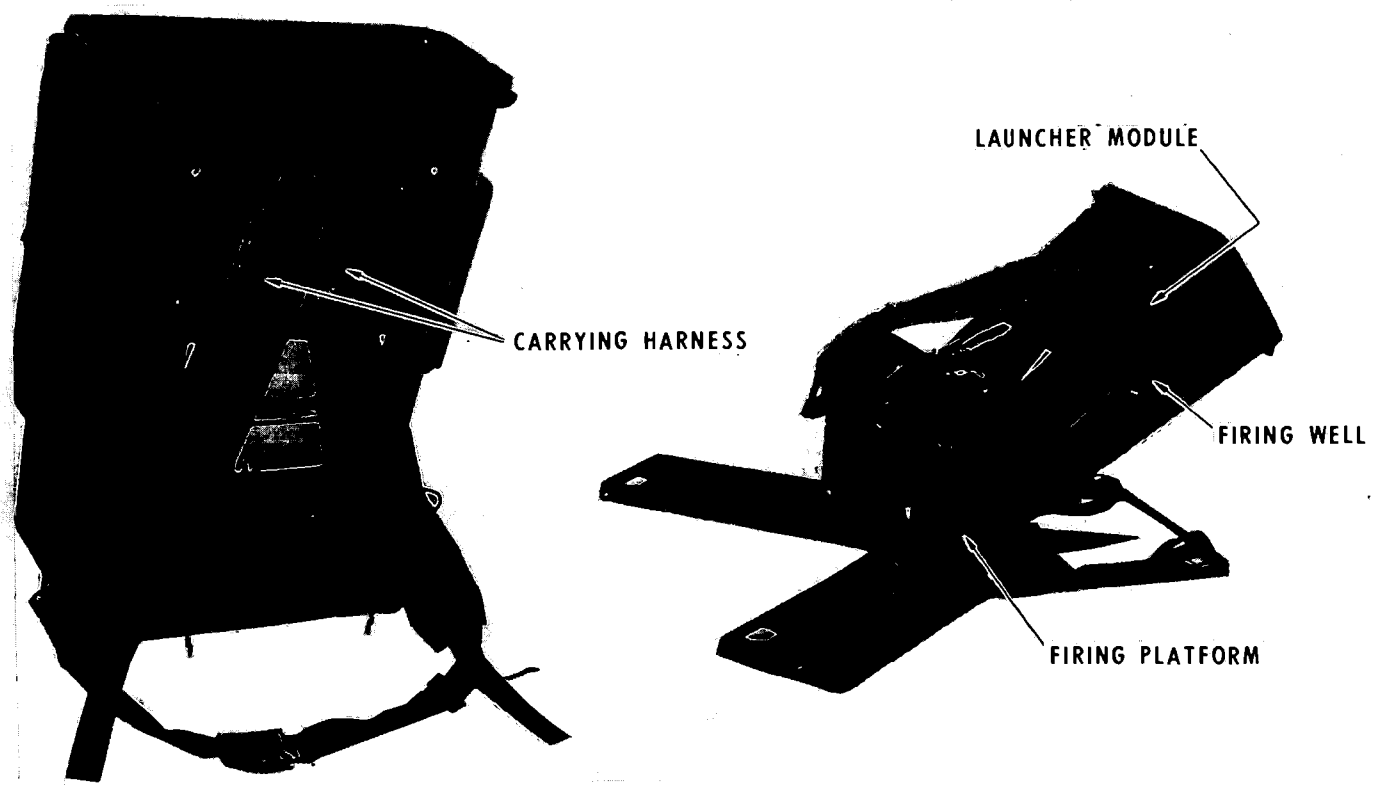


Figure 4–7. Launcher and 35mm cartridge: tactical CS, 16-tube, E8.

an effective concentration over about 2,500 square meters. Firing two E8s on the same area produces an effective agent concentration over a significantly larger area than a single E8. The cloud from two launchers is dispersed more uniformly and remains effective considerably longer.

d. Use. The E8 launcher is a short range weapon that can be used to place quantities of CS on point and small area targets in conjunction with assault by ground forces. It is an invaluable aid in perimeter security, convoy security, counterambush, combat assault, and can be used in ambushes or for breaking contact.

4–5. Dispersers

Currently available dispersers have little tactical application. The CS cloud is generated at the weapon itself much as a crop duster or smoke generator. Because of their short range, they cannot be used where the operator will be exposed to enemy fire. They can be used to blow CS1 or CS2 into an undefended tunnel entrance to produce residual contamination which will discourage entry by unmasked personnel. In addition, the M106 disperser has a blower system that enables it to blow the agent cloud from burning CS hand

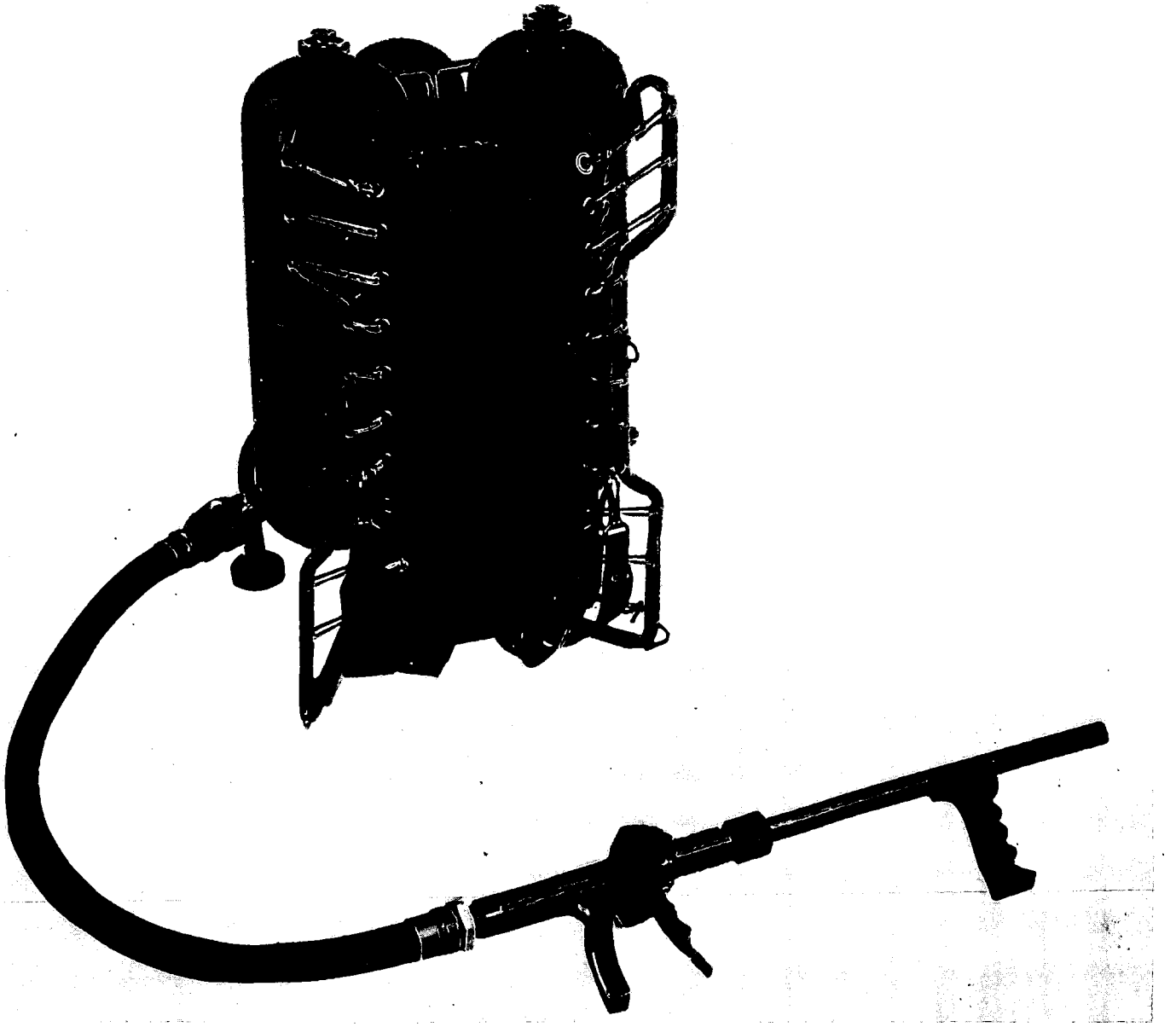


Figure 4–8. Disperser, riot control agent, portable, M3.

grenades through a tunnel to force unmasked personnel to evacuate the tunnel, or to blow smoke from burning smoke grenades through a tunnel to locate all vents and entrances.

a. Disperser, Riot Control Agent, Portable, M3 (fig. 4–8).

(1) *Status.* Standard–A, Army.

(2) *Description.* The M3 consists of a disperser gun, agent tank and pressure unit, and hose. It is mounted on the back of the operator. Air, under pressure, forces the agent from the agent tank and expels it from the gun in a cloud.

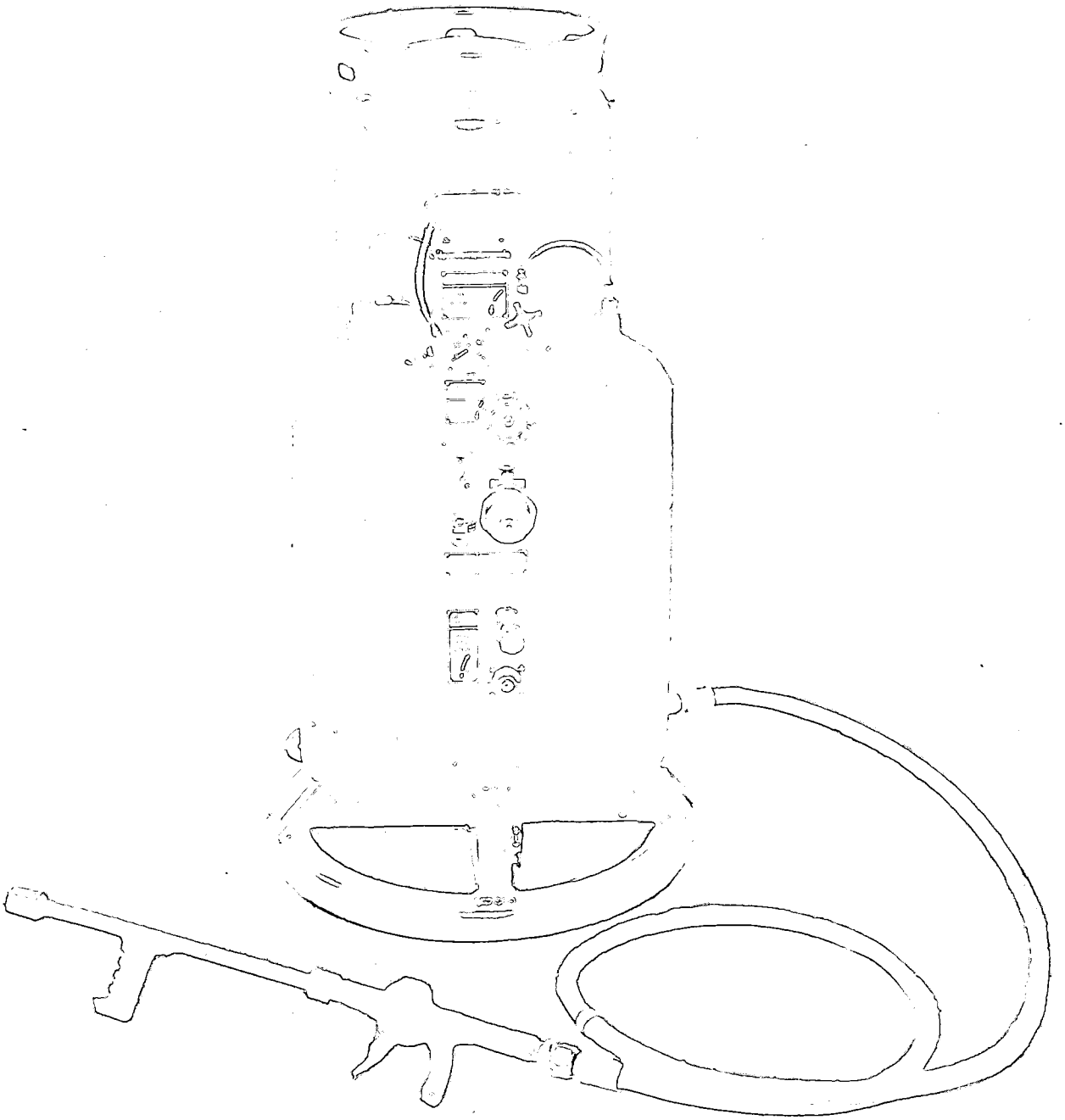


Figure 4–9. M5 disperser.

The disperser is capable of disseminating approximately 8 pounds of CS1 or CS2 in one continuous burst of 19 seconds, or in intermittent bursts for 30 seconds. The agent is projected about 10 meters before it billows out into a cloud. Reference: TM 3–1040–214–12.

(3) *Area coverage.*

Amount of agent	Windspeed (knots)	Area Coverage (m^2)	Effective downwind travel (m)
Single filling	3 to 5	2,300 to 3,800	Greater than 200

b. M5 Disperser (fig. 4–9).

(1) *Status.* Standard–A, Army.

(2) *Description.* The M5 helicopter- or vehicle-mounted riot control agent disperser is used to disperse CS1 or CS2 into the atmosphere from either a low-flying cargo helicopter or a moving ground vehicle. The disperser consists of four basic groups: a base group, a container group, a pressure group, and an accessories group. CS is dispersed by forcing powdered agent from the container group into the atmosphere through a delivery hose with pressurized air from the pressure group. The agent tank holds about 50 pounds of CS1 or CS2. The M5 disperser has a range of about 12 meters in still air (with gun) and 15 to 46 meters from a helicopter (helicopter elevation: 75 to 100 feet.) Duration of fire per fill is 12 minutes (gun) and 20 seconds (helicopter hose). Reference: TM 3–1040–220–12.

(3) *Area coverage.* About 50,000 square meters.

c. Disperser, Riot Control Agent, Back-Pack, 450 CFM, M106 (Mity Mite) (fig. 4–10).

(1) *Status.* Standard–A, Army.

(2) *Description.* The M106 is a modified agricultural sprayer-duster, designed to disperse dry and liquid agents by means of a high velocity air stream. It is mounted on an L-shaped frame which is equipped with shoulder straps that permit an individual to carry the disperser on his back. The disperser is powered by a gasoline engine and has a blower capable of displacing 450 cubic feet of air per minute. Components include an agent tank with a capacity of 10 pounds of CS1 or CS2, an air duct and liquid tube assembly, and a 6-foot air duct hose. The air duct and liquid tube assembly is used for spraying bulk CS in the open; the 6-foot air duct hose is used for blowing air to force CS or smoke from burning-type grenades into tunnels. The disperser may be

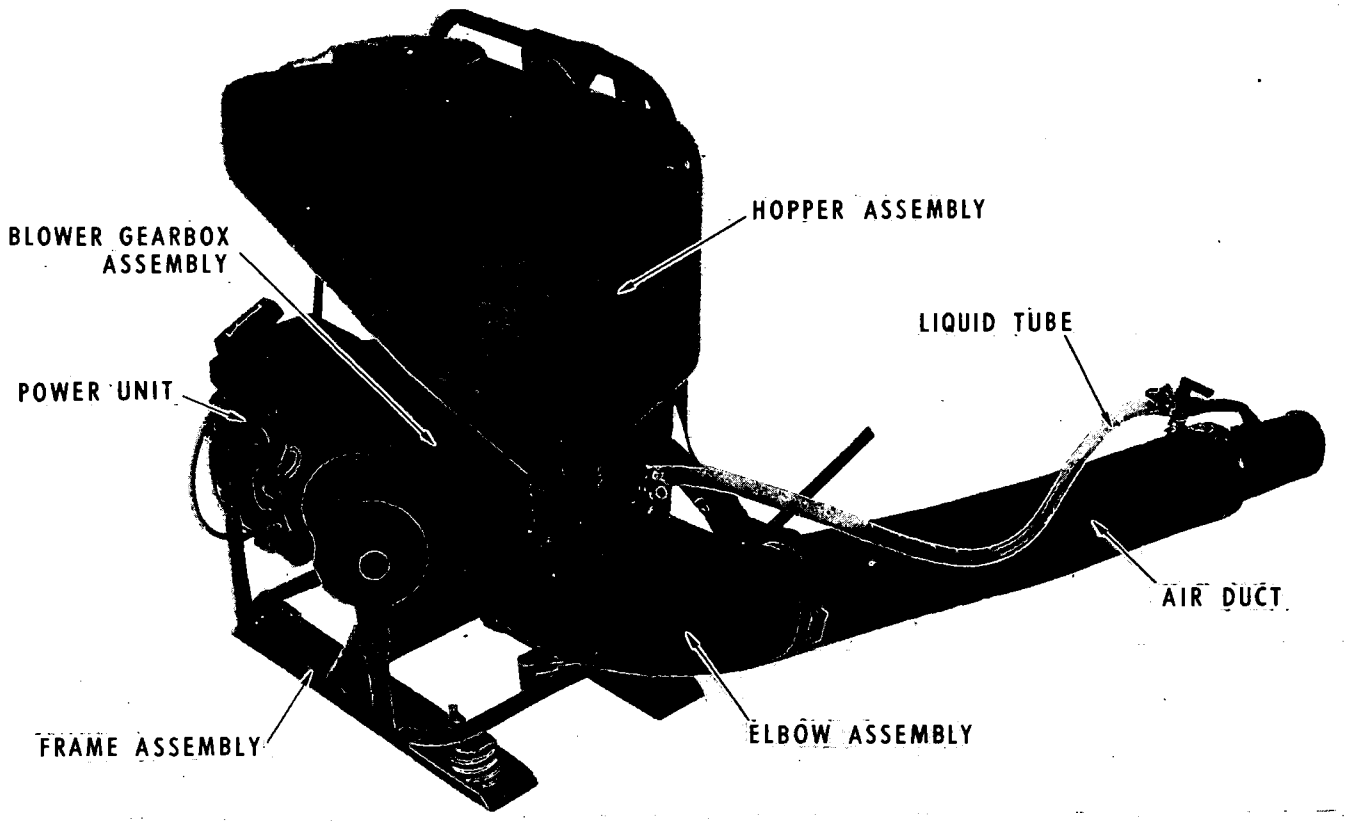


Figure 4–10. Disperser, riot control agent, back-pack, 450 CFM, M106 (Mity Mite).

carried on an individual's back, mounted on a vehicle, or placed on the ground. Reference: TM 3–1040–254–13.

(3) *Area coverage.* An agent cloud will penetrate a typical tunnel with no branches at a speed of about 15 meters per minute when one M106 disperser is used.

4–6. Air-Delivered CS Munitions

a. Munitions Dispensing Burning-Type Submunitions.

(1) *Canister Cluster, Riot Control Agent: CS, XM15(E158) (fig. 4–11).*

(*a*) *Status.* XM15: Developmental, Army. Scheduled for type-classification in the fourth quarter, FY 70.
E158R2: ENSURE–LP, Army. Will not be type-classified.

(*b*) *Description.*

Note. The description given here is specifically for the XM15; however, concepts of use, area coverage, and techniques for employment are the same for the E158R2 which is being replaced by the XM15.

The XM15 canister cluster is an antipersonnel weapon containing CS. The cluster consists of 8 modules, a fuze-bar assembly, and a fuze assembly. The 8 modules, which are made of molded Surlyn plastic, are heat-sealed together. Each module contains 33 XM16 CS canisters. The canister is the basic point-source disseminator of the agent and consists of a fuze assembly and an aluminum case into which the CS pyrotechnic mixture has been pressed. The XM15 is carried internally on cargo and utility helicopters (UH–1 and CH–47). Functioning occurs when the cluster is dropped. An arming wire initiates a mechanical time initiator and releases an interrupter from its position, blocking the detonator slide. At the completion of these functions, the detonator impacts a firing pin and detonates; thereby igniting the pyrotechnic *delay* fuze which ultimately ignites the individual canisters and explosively ejects them from the plastic modules. The canisters disseminate agent for 4 to 6 seconds. The XM15 is hand-dropped from helicopters and provides a multipoint source of CS for area targets. The space available is the primary limitation on the number of units that can be delivered by one aircraft. Reference: TM 3–1325–232–12.

Note. The XM15/E158 can be released from aircraft 700 to 4,000 feet above ground level (AGL). The mechanical time fuze must be set to function at 400 to 500 feet AGL. If munitions are released below the minimum altitude of 700 feet, the modules will not have time to properly activate and target coverage may not be achieved.

(*c*) *Area coverage.* One munition will cover an area with a radius of about 40 meters (5,000 square meters). The number of munitions required will be determined by observing the effects on target.

(*d*) *Use.* The XM15 is an effective munition for providing rapid coverage over a large area with an intolerable concentration of airborne CS. It can also be used on an entrenched enemy before assault; to suppress antiaircraft fire near landing zones; for reconnaissance; on enemy-held villages where combatants are intermingled; and to break contact with the enemy.

(2) *Canister Cluster Assembly, Riot Control Agent: CS, XM165 (E159, CBU–19/A) (fig. 4–12).*

(*a*) *Status. XM165:* Developmental, Army. Scheduled for type-classification in fourth quarter, FY 70.
E159: ENSURE–LP, Army. Not to be type-classified, CBU–19/A: Obsolete, Air Force.

(*b*) *Description.*

Note. The description given here is specifically for the XM165; however, concepts of use, area coverage, and techniques for employment are the same for the E159, which is being replaced by the XM165.

The XM165 canister cluster consists of two XM15 subclusters fitted to a strongback. It can be made to function either electrically or mechanically. An explosive bolt is initiated by a signal from the pilot. As the bolt shears, the two subclusters are forced downward by four leaf springs located under the strongback, and functioning occurs as described for the XM15. The XM165 is carried externally on lowspeed aircraft. It can be released from aircraft 700 to 4,000 feet AGL at 0 to 300 knots. Reference: TM 3–1325–230–12.

(*c*) *CBU–19/A.* The CBU–19/A is the Air Force designation for the E159. It is equipped with a modified wiring harness to permit electrical functioning from low-performance Air Force aircraft. This item is obsolete and no longer in production but may be in inventory.

(*d*) *Area coverage.* One munition will cover an area with a radius of about 60 meters (11,000 square meters).

(*e*) *Use.* Concepts of use are essentially the same as for the XM15 (para 4–6*d*); however, the XM165 is rarely used in current operations

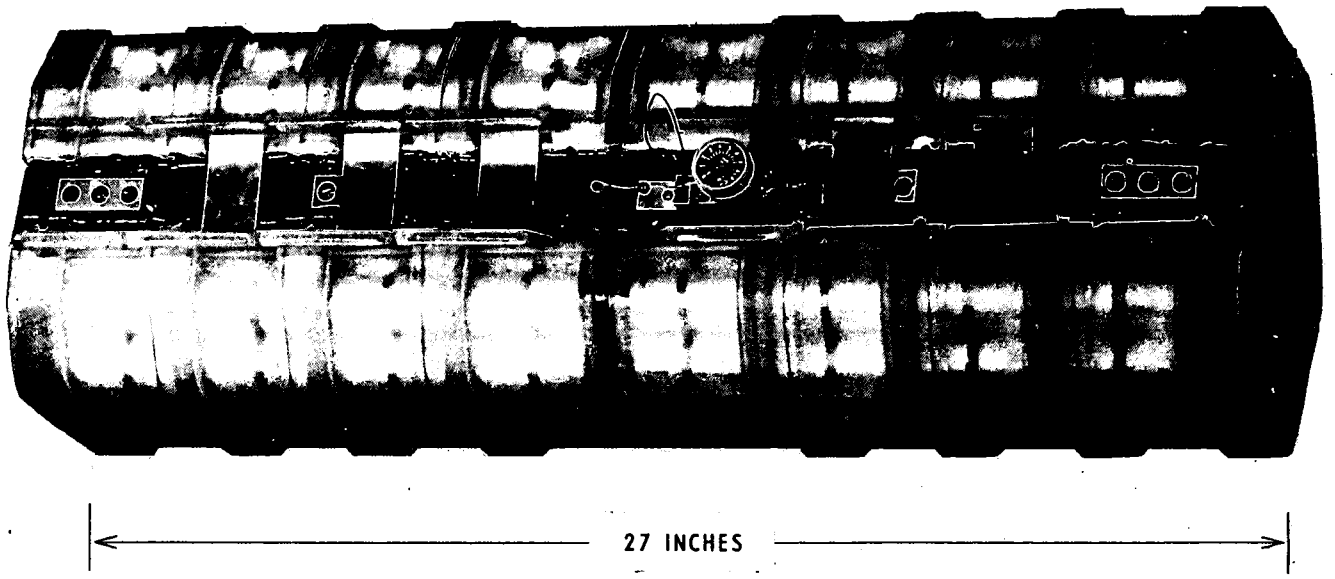


Figure 4–11. Canister cluster, riot control agent: CS XM15.

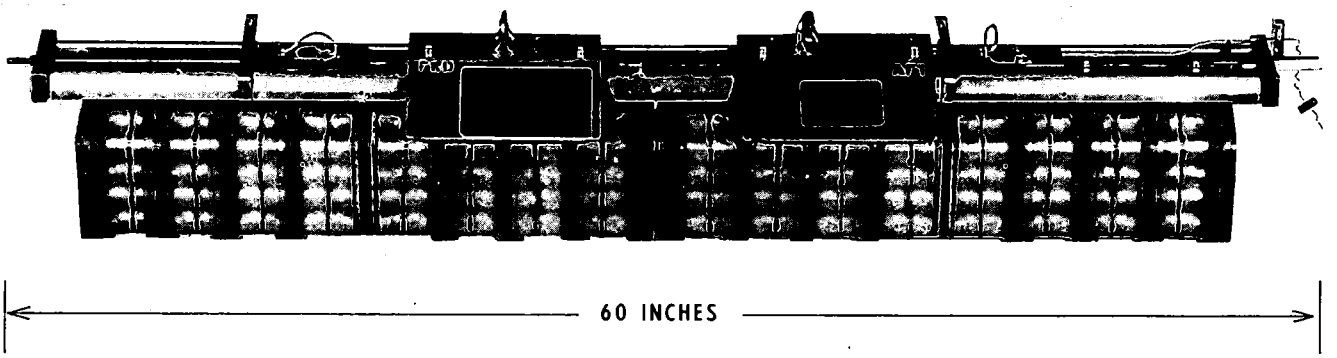


Figure 4–12. Canister cluster assembly, riot control agent: CS, XM165.

because aircraft capable of delivering it usually have higher priority missions.

(3) *2.75-inch CS folding-fin rocket, XM99 (fig. 4–13).*

(*a*) *Status.* XM99: ENSURE—LP, Army.

(*b*) *Description.* The XM99 is a 2.75-inch folding fin aircraft rocket (FFAR) which consists of an XM236 warhead, CS submunitions,

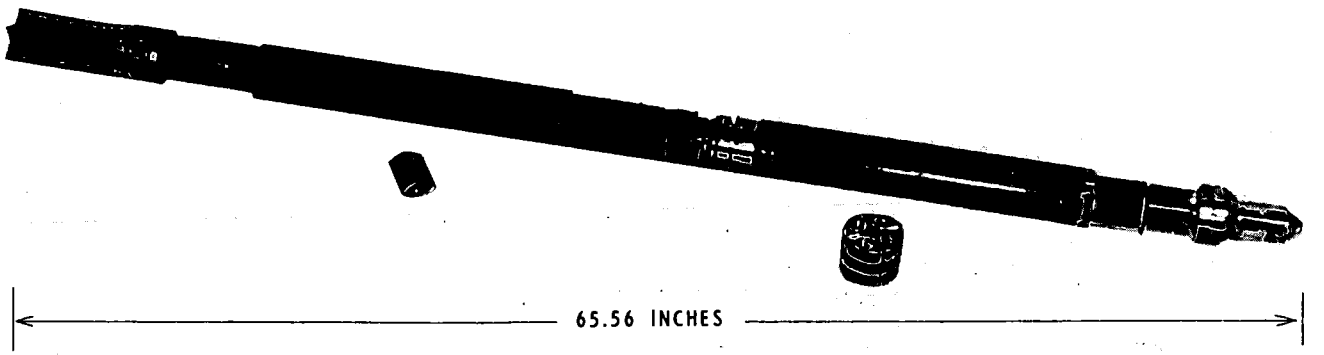


Figure 4–13. 2.75-inch CS folding-fin rocket, XM99.

and proximity fuze. It is fired from the XM159C or the XM200 19-round rocket launcher. Each warhead is fitted with 32 submunitions filled with CS-pyrotechnic mix. The XM99 is employed from helicopters equipped to fire 2.75-inch rockets.

(*c*) *Area coverage.* Not available.

(*d*) *Use.* The XM99 has a stand-off capability and is particularly effective against discrete targets in open, urban, and rural (including heavy wooded) areas and jungle terrain.

(4) *CBU–30/A Dispenser Munition System (fig. 4–14 and fig. 4–15).*

(*a*) *Status.* LP, Air Force.

(*b*) *Description.* The CBU–30/A is designed to produce a line source of CS when delivered from high- or low-performance aircraft. It consists of the SUU–13/A dispenser (fig. 4–14) and 40 CDU–12/B clusters (fig. 4–15). The clusters are fired singly, in a ripple sequence, as long as the bomb release button is depressed. The time delay between firings can be preselected before takeoff. Each cluster bursts before impact, releasing 32 BLU–39 CS bomblets (a total of 1,280 bomblets per dispenser). The bomblet is a cylindrically shaped aluminum canister containing CS-pyrotechnic mixture. It is a skittering-type bomblet with a 5- to 6-second delay fuze and a burning time of about 17 seconds. The BLU–39 is identical to the XM16 canister used in the XM15/XM165 tactical CS cluster.

(*c*) *Munitions Requirement.* Table 4–1 gives the number of dispensers required to produce an effective concentration along and at various downwind distances from a dissemination line one kilometer long. Data are presented for windspeeds of .5, 1, 2, 5, and 9 knots and for stable, neutral, and unstable atmospheric conditions. Windspeeds of .5 to 1 knot are prevalent in jungle or heavily wooded areas while windspeeds of 2.5 to 9 knots usually occur in open terrain. These figures are based on a 100-millisecond intervalometer setting which produces a line about 1,000 meters long. No fewer than two dispensers should be delivered on one target, and when only two are used, they should be delivered simultaneously.

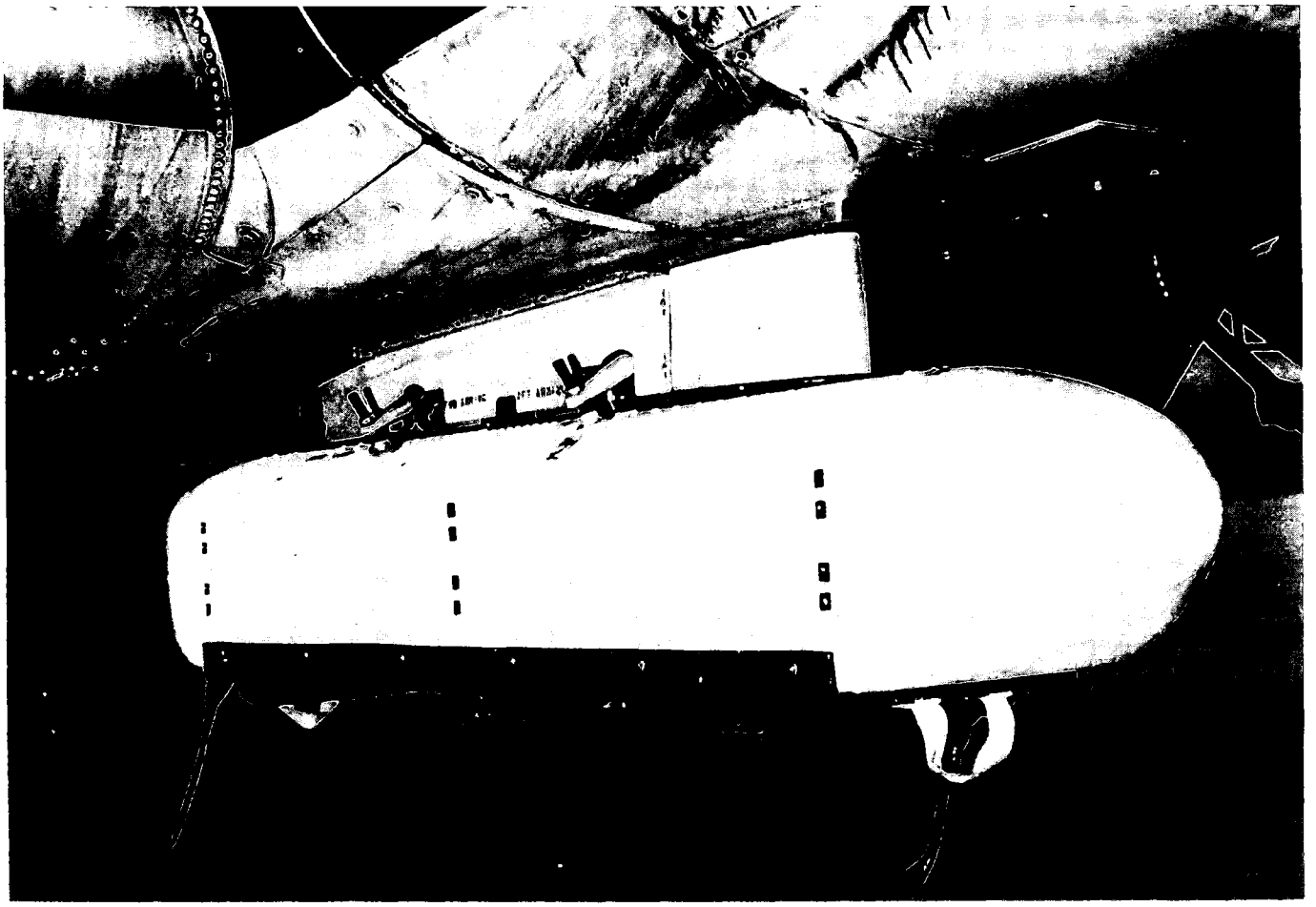


Figure 4–14. SUU–13/A dispenser.

TABLE 4-1

MUNITIONS REQUIREMENT FOR THE CBU-30/A CS DISPENSER

CROSSWIND* DISTANCE (meters)	DOWNWIND DISTANCE (meters)	ATMOSPHERIC CONDITIONS														
		STABLE					NEUTRAL					UNSTABLE				
		WINDSPEED (knots)														
		.5	1	2	5	9	.5	1	2	5	9	.5	1	2	5	9
		NUMBER OF DISPENSERS REQUIRED														
1,000	100	2	2	2	3	4	2	2	2	3	5	2	2	3	6	12
1,000	200	2	2	2	3	4	2	2	2	3	5	2	2	8	17	22
1,000	300	2	2	2	3	5	2	2	2	4	7	2	2	16		
1,000	400	2	2	2	3	5	2	2	2	5	8	2	3	26		
1,000	500	2	2	2	3	5	2	2	2	5	9	2	3			
1,000	600	2	2	2	3	6	2	2	3	6	10	2	4			
1,000	700	2	2	2	4	6	2	2	3	7	11	3	5			
1,000	800	2	2	2	4	6	2	2	3	8	12	3	5			
1,000	900	2	2	2	4	7	2	2	4	8	14	3	6			
1,000	1,000	2	2	2	4	7	2	2	4	9	15	3	6			

*This is the line produced by one dispenser using a 100-millisecond setting with aircraft speed of 500 knots.

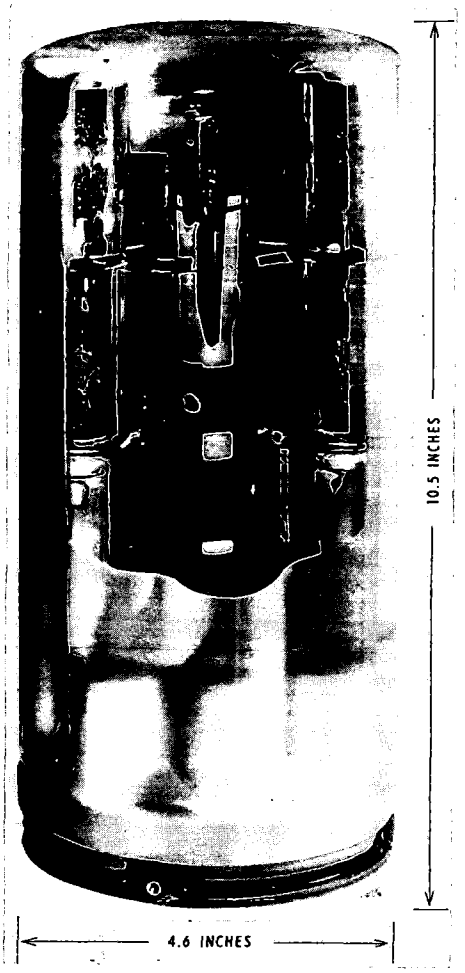


Figure 4–15. CDU–12/B bomb cluster.

(*d*) *Use of Table 4–1.* As an example of the use of the table, assume that a target 1,000 meters by 500 meters must be covered with an effective concentration. Assume that a 5-knot wind is blowing parallel to the short side (500 meter) of the target and that the atmospheric condition is stable. Table 4–1 shows that three dispensers functioned simultaneously on the upwind edge of the target will produce an effective concentration to at least 600 meters downwind. The line produced by these dispensers, using a 100-millisecond intervalometer setting at 500 knots, will be about 1,000 meters long. Therefore, the target can be effectively covered by using three dispensers.

b. Munitions for Dispensing Bulk Agent (CS1 or CS2). These munitions are used in operations where long-lasting contamination with CS1 or CS2 is desired. They can be used to interdict and harass enemy lines of communication in search and clear operations. They can be used to restrict the enemy's use of infiltration routes, base camps, assembly areas, underground tunnels, and dug-in fighting positions. Sufficient agent can be disseminated at one time by munitions discussed below to ensure a long period of restriction; however, significantly fewer munitions will be required if the contamination is replenished periodically.

(1) *Fuze and Burster, Bomb: System XM925 (fig. 4–16).*

(*a*) *Status.* ENSURE, Army.

(*b*) *Description.* The XM925 system consists of an XM923 fuze, XM55 burster, and a 55-gallon drum of CS1 or CS2. The XM923 fuze is a vane-arming omidirectional impact fuze. A 10-foot lanyard is included to permit air arming of the fuze after the safety pin has been removed. The CS drum is a special 55-gallon drum, which is separately supplied, and contains 10 eight-pound bags of CS1 or CS2. The drum has a burster well down through the center which allows the XM55 burster to be installed. Some drums have been supplied to the field without burster wells installed. In this case the burster well is supplied along with a prepunched drum lid, and the bursters are installed by the user in the field. The burster well is a cylindrical tube containing at 9.5-pound salt annulus which minimizes flashing when the burster is detonated. The CS-filled drums are airdropped from utility and cargo helicopters. The CH–47 can be fitted with an improvised rack and roller system for delivering the drums on target. (See TM 3–1325–237–10)

Caution: **To ensure proper air arming and aircraft/munitions separation, the munitions should be released at a minimum airspeed of 50 knots at 2,000 feet AGL.**

(System drops with the XM923 fuze at heights of less than 2,000 feet may result in some duds from failure to arm.) Reference: TM 3–1325–237–10.

(*c*) *Munitions Requirement.* Table 4–2 gives the number of munitions required to contaminate an area 440 X 1,000 meters.

(2) *Dispenser and Bagged Riot Control Agent, Helicopter, CS2, XM28 (fig. 4–17).*

(*a*) *Status.* ENSURE–LP, Army.

(*b*) *Description.* The XM28 is a rectangular shaped, aluminum alloy dispenser with a stabilizing tail-fin assembly. It is 36 inches high, 33 inches wide, and 95 inches long (without tail assembly). The XM28 has nineteen cardboard compartments that are held in the dispenser by individual doors. Each compartment holds 110 paper bags filled with 0.35 pound CS2—a total of 2090

TABLE 4-2

55-GALLON DRUM CS MUNITION EXPENDITURE TO CONTAMINATE

AN AREA 400 X 1,000 METERS

PROBABILITY OF EFFECTIVENESS AGAINST UNMASKED PERSONNEL	FOREST					JUNGLE
	RESTRICTION TIME (days)					
	1	5	10	15	20	1
	NUMBER OF MUNITIONS REQUIRED					
.1			80	90	130	90
.2	60	70	90	110	160	100
.3	70	80	110	130	210	110
.4	80	90	120	150	260	120
.5	90	110	140	175	340	130
.6	110	130	160	210	450	150
.7	130	150	180	340		180
.8	140	180	290			220
.9	180	230				320

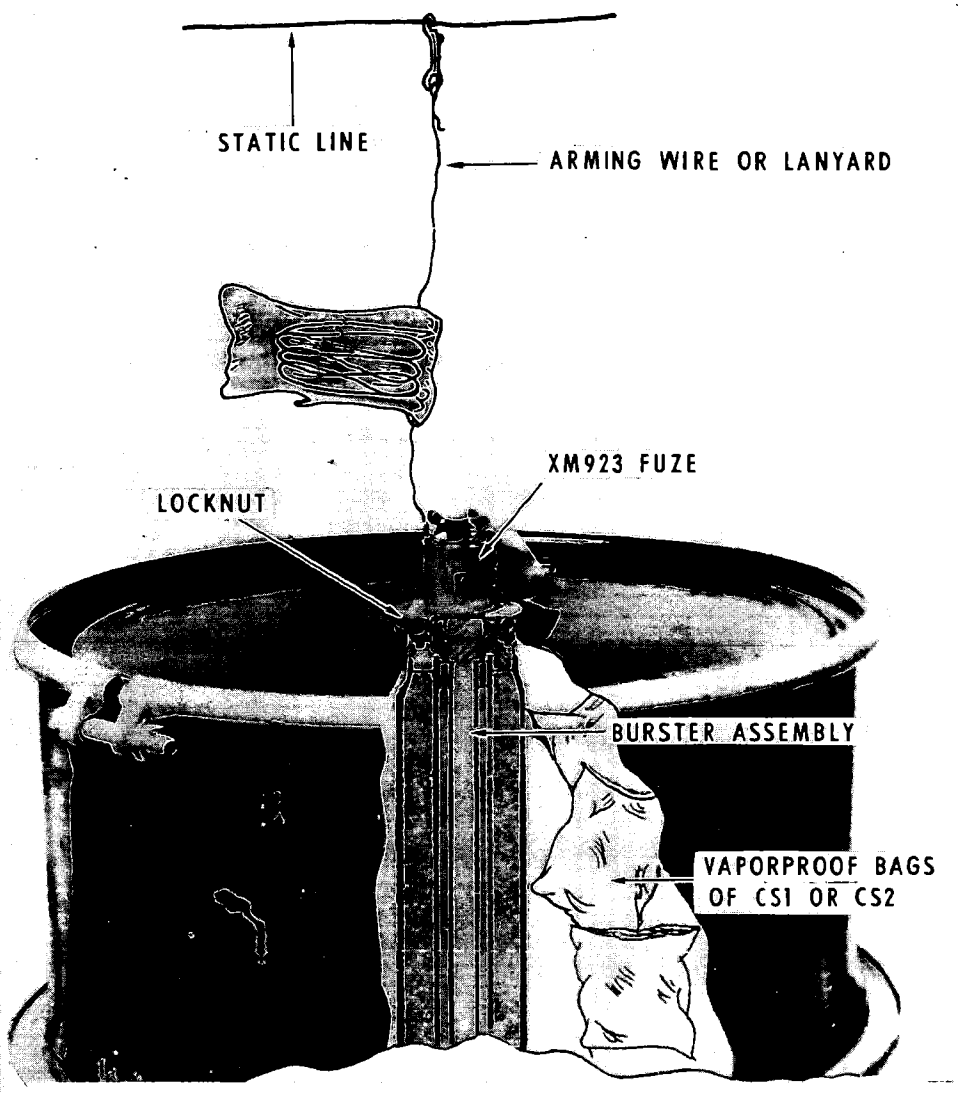


Figure 4–16. Fuze and burster, bomb: system, XM925.

bags and 760 pounds of agent for each dispenser. The trap-type doors on the compartments are released by explosive detents sequentially functioned by an electrical intervalometer. (The dispenser door release time is set on the intervalometer before flight in accordance with a predetermined helicopter release speed.) When the push-button firing switch is actuated, the paper bags fall from the dispenser and burst on ground impact. The XM28 is carried slung beneath a helicopter. The XM28 system has the advantages of shorter response time, greater accuracy, and increased residual effect when compared with the 55-gallon drum method of terrain contamination.

(*c*) *Area coverage.* Area coverage will depend on airspeed, release altitude, and intervalometer setting. At 80 knots, 1,500 feet AGL, and 0.2-second intervalometer setting, one munition should cover an area 310 by 41 meters. Optimum release conditions will depend on terrain and aircraft vulnerability.

(3) *Chemical Bomb, BLU–52A/B (fig. 4–18).*

(*a*) *Status.* Standard, Air Force.

(*b*) *Description.* The BLU–52A/B is a modified BLU–1C/B fire bomb. It is an aluminum alloy shell, filled with 260 pounds of agent CS2. Total weight of the bomb is 350 pounds. The BLU–52 contains no explosives or fuzes and depends upon dynamic impact to disperse the agent. When filled with CS1 the bomb designation is BLU–52/B. These bombs can be delivered by low- and high-performance tactical aircraft. The best coverage is obtained by using a 15° to 20° dive angle.

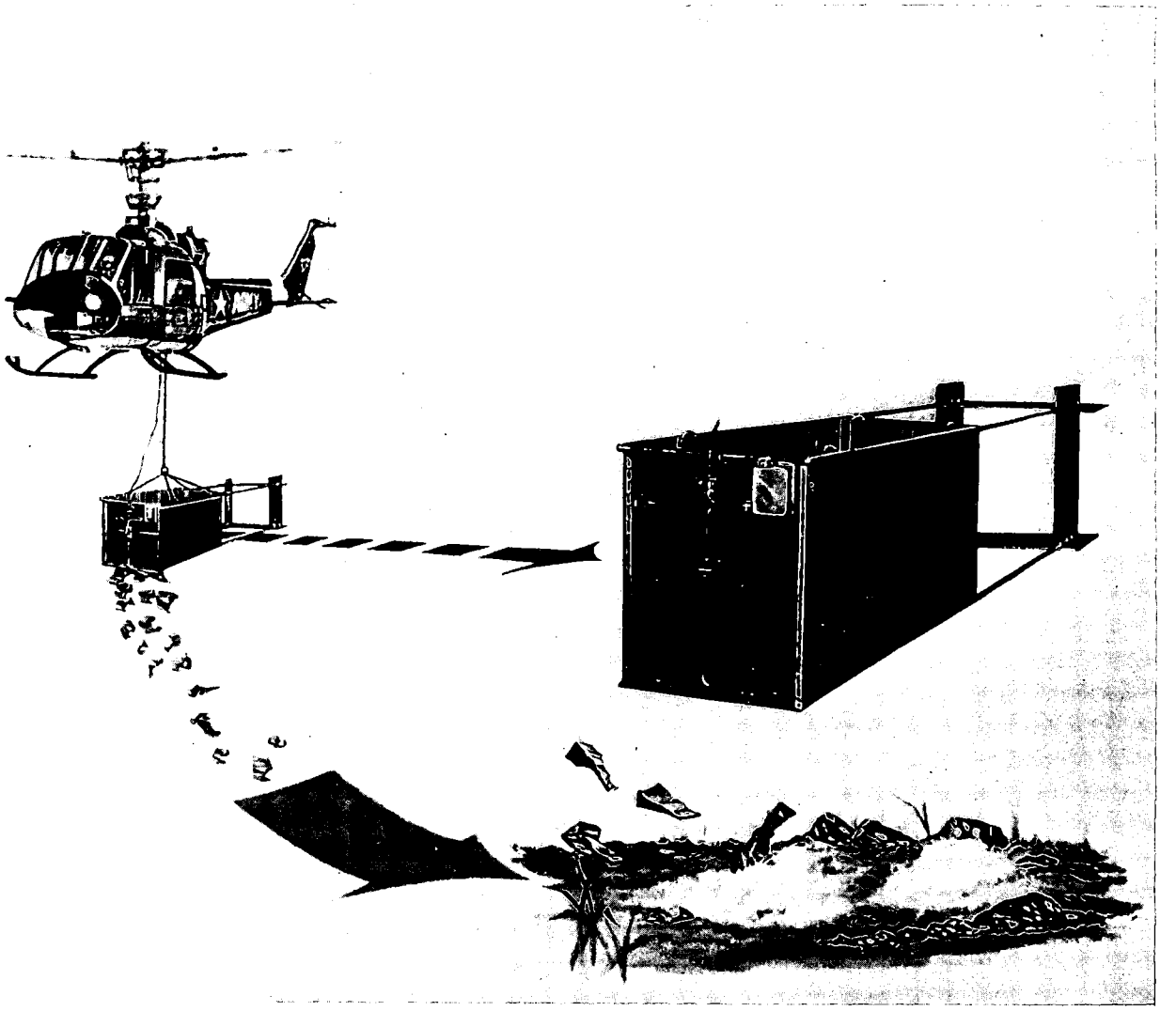


Figure 4-17. Dispenser and bagged riot control agent, helicopter, CS2, XM28.

c. Munitions Requirement. Table 4-3 presents estimates for the number of munitions required to contaminate an area 400 meters wide by 1,000 meters long. Target lines in excess of 1,000 meters will require a proportional increase in the number of munitions used. These estimates are based on results obtained in actual traversal attempts by unprotected troops.

d. Use of Tables 4-3 and 4-4.

(1) *Table 4-3.* As an example of the use of table 4-3, assume that an area 400 by 1,000 meters in a forest environment must be contaminated. If a .6 probability of effectiveness among unmasked personnel crossing the contaminated area is desired, table 4-3 shows that 50 munitions would be required to effectively restrict the use of the area for 24 hours.

(2) *Table 4-4.* Table 4-4 shows the effective crosswind spread of the aerosol cloud produced by one BLU-52A/B CS munition. For an example of the use of table 4-4, assume that it is desired to know the crosswind spread of an effect CS cloud 500 meters downwind from the point of impact under the following conditions: 1 knot windspeed, jungle terrain, and neutral atmospheric condition. Table 4-4 shows that at 500 meters downwind the effective aerosol cloud would be about 200 meters wide. At a downwind distance of greater than 500 meters, the cloud would not be effective. Table 4-4 also shows that with an 8-knot windspeed, over open terrain, and under neutral atmospheric conditions, the CS cloud produced by one BLU-52A/B munition has a very narrow crosswind spread. Normal variations in wind direction make it very difficult to predict the true path of the cloud.

TABLE 4-3

BLU-52A/B MUNITION EXPENDITURE TO CONTAMINATE AN AREA 400 X 1,000 METERS

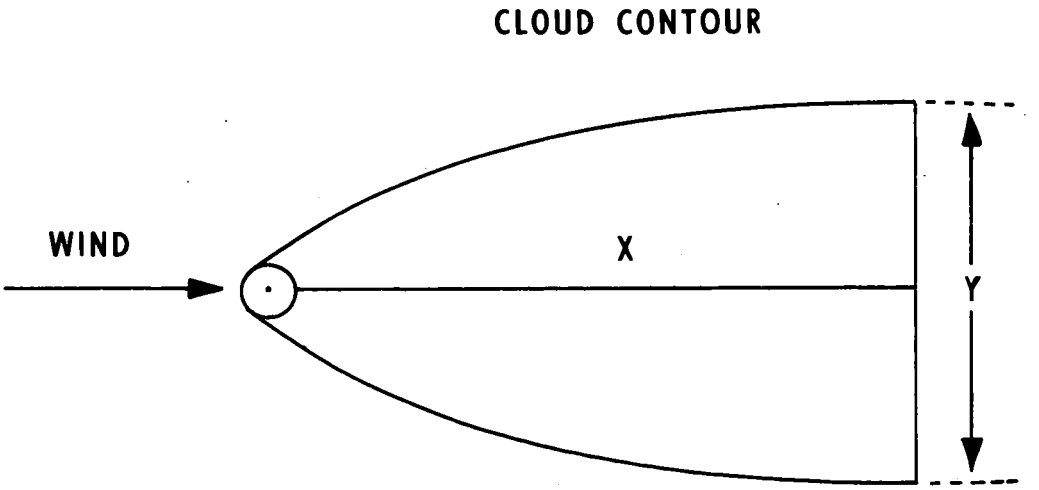
PROBABILITY OF EFFECTIVENESS AGAINST UNMASKED PERSONNEL	FOREST					OPEN TERRAIN					OPEN WATER	JUNGLE	TALL GRASS
	RESTRICTION TIME (days)												
	1	5	10	15	20	1	5	10	15	20	1	1	1
	NUMBER OF MUNITIONS REQUIRED												
.1				50	60			50	75	110			
.2			50	55	70			65	115	165	45	45	
.3			50	60	90			80	160	265	45	50	45
.4			55	70	115			105	260		45	55	50
.5		50	65	90	140	45	50	140	435		50	60	55
.6	50	60	80	120	190	45	50	185			55	70	60
.7	55	65	105	170	360	45	55	255			60	90	65
.8	65	85	160	320		45	65	370			80	125	75
.9	90	150	345			50	85	520			150	175	115

TABLE 4-4

CROSSWIND SPREAD OF EFFECTIVE CS CLOUD BY ONE BLU-52A/B

(Neutral Conditions)

DOWNWIND DISTANCE (meters)	JUNGLE (Windspeed - 1 knot)	OPEN TERRAIN (Windspeed - 8 knots)
	CROSSWIND DISTANCE (meters)	
10	40	30
50	80	30
100	100	30
200	200	35
300	250	40
400	250	40
500	200	45
1,000	Not effective	60
2,000	Not effective	50
3,000	Not effective	Not effective



X - DOWNWIND DISTANCE
Y - CROSSWIND DISTANCE

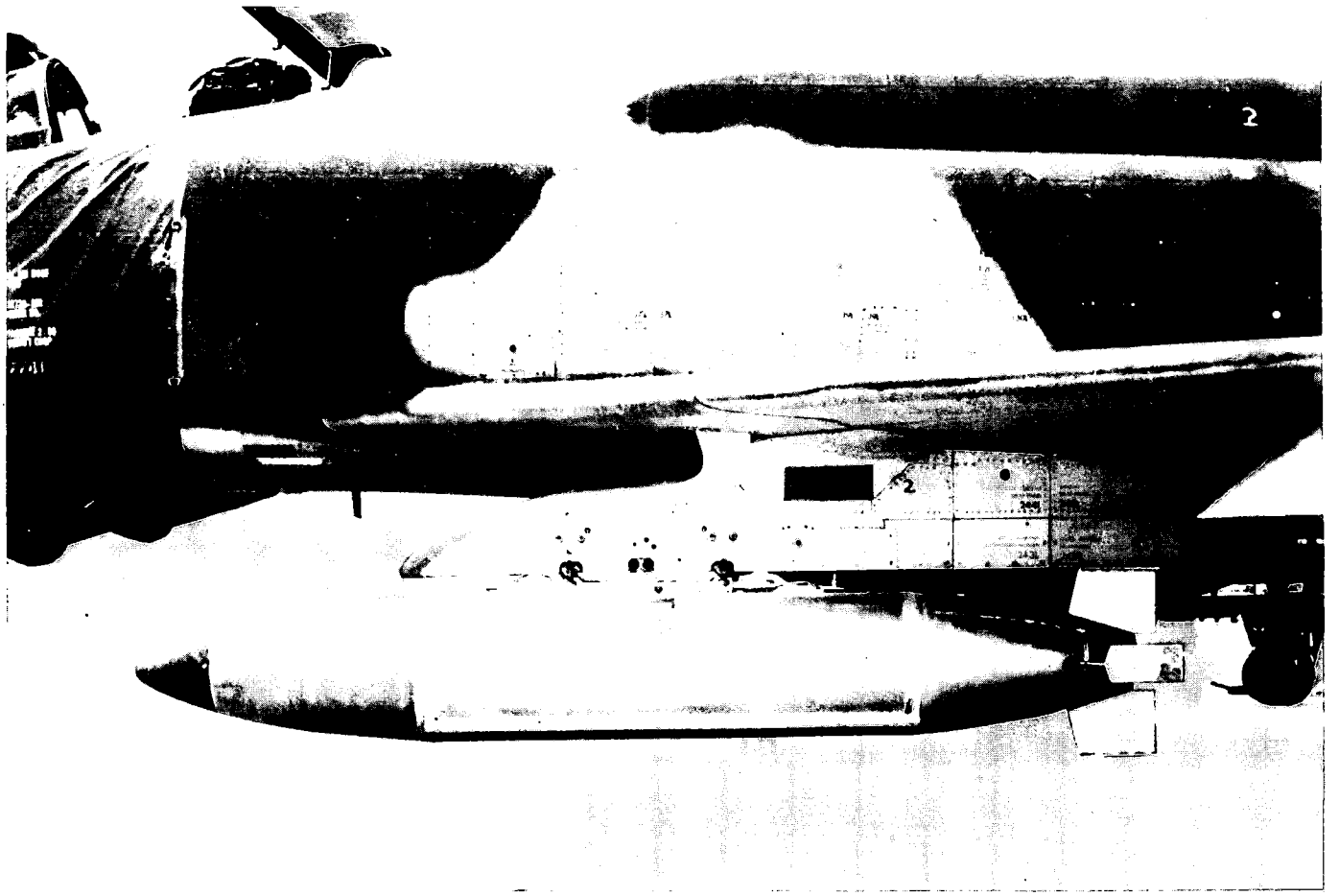


Figure 4–18. Chemical bomb, BLU–52A/B.

4–7. Mortar and Artillery CS Cartridges

a. Cartridge, 4.2-Inch: Tactical CS, XM630 With Fuze, MTSQ, M548 (fig. 4–19).

(1) *Status.* ENSURE—LP, Army.

(2) *Description.* The XM630 is designed for use in the M30 mortar and consists of an XM633 projectile body containing four CS-filled canisters, MTSQ fuze M548, and a tail assembly.

(3) *Target effects.* Refer to appendix B.

(4) *Use.* It may be used for direct support of maneuver elements, on known or suspected targets, to harass and confuse the enemy so that his ability to fire and maneuver is degraded. The XM630 will penetrate a triple canopy jungle and is effective against enemy night attack. It is also used for counterbattery and countermortar fire. One advantage of the XM630, 4–2-inch CS round over the air-delivered XM15 is the attainment of surprise.

b. Cartridge, 105mm: Tactical CS, XM629 with Fuze, MTSQ, M548 (fig. 4–20).

(1) *Status.* ENSURE—LP, Army.

(2) *Description.* The XM629 is a semi-fixed, base-ejecting round designed for use in 105mm howitzer cannons. The main components of the round are the XM632 projectile containing four XM8 CS-pyrotechnic filled canisters, a cartridge case, and MTSQ fuze M548. The M548 fuze is designed to function at a set time or upon impact.

(3) *Target effects.* Refer to appendix C.

(4) *Use.* The 105mm CS cartridge can be used to rout the enemy from cover, for close support, and is especially effective in search and clear operations. It is also used for H&I and counterbattery and countermortar fire.

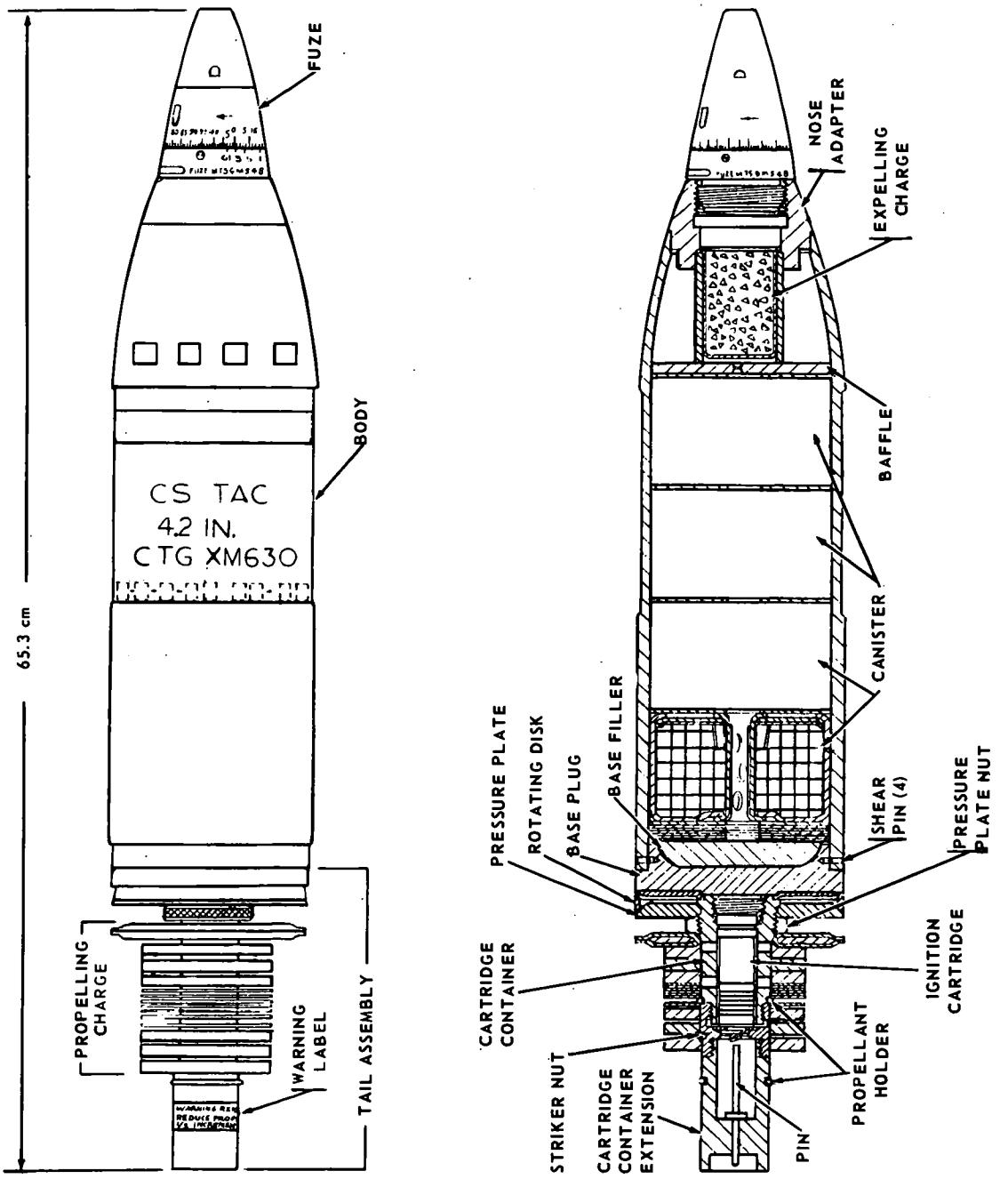


Figure 4–19. Cartridge, 4.2-inch: tactical CS, XM630 with fuze, MTSQ, M548.

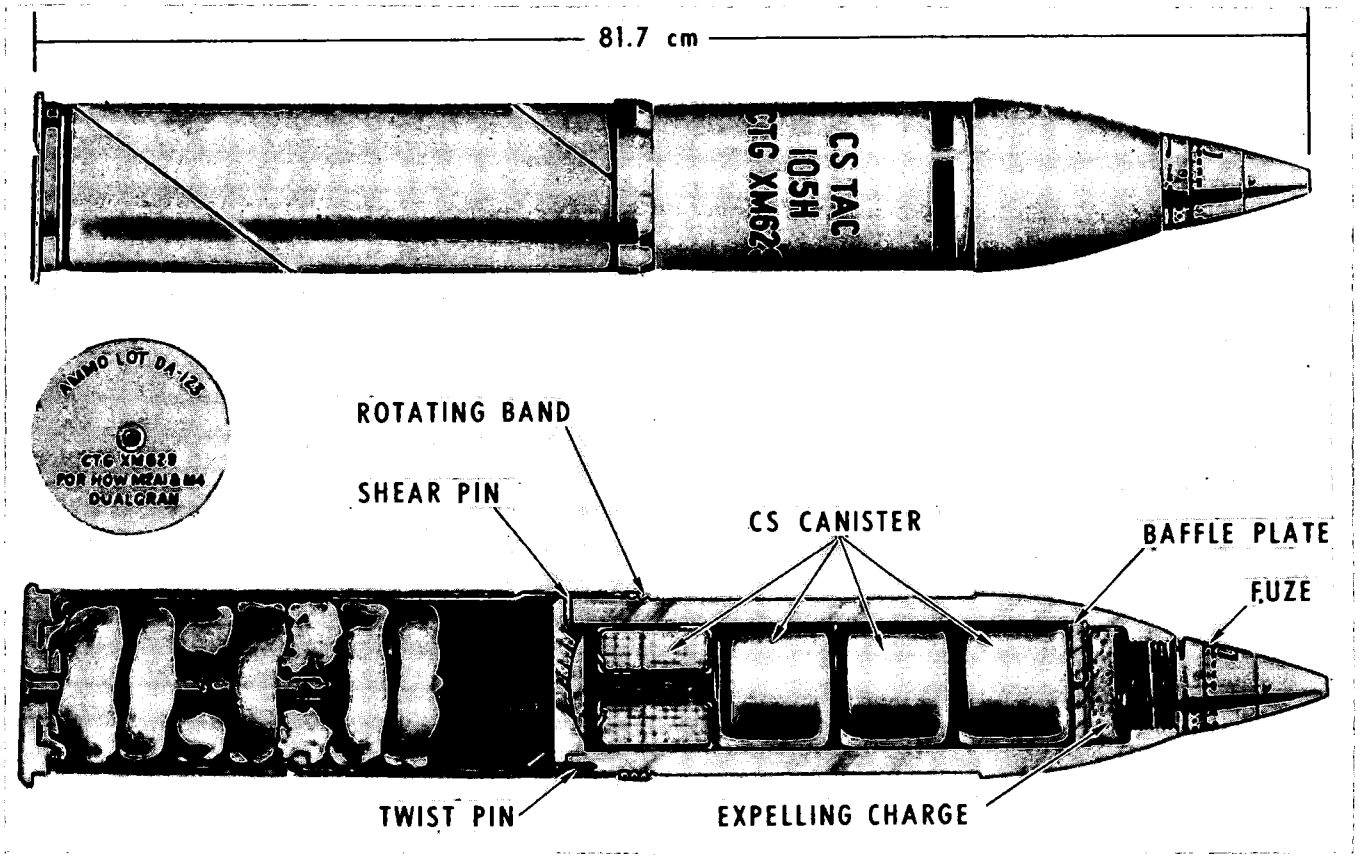


Figure 4–20. Cartridge, 105mm: tactical CS, XM629 with fuze, MTSQ, M548.

APPENDIX A

REFERENCES

FM 23–30	Grenades and Pyrotechnic Signals.
FM 101–40	Armed Forces Doctrine for Chemical and Biological Weapons Employment and Defense.
TM 3–1040–214–12	Operator and Organizational Maintenance Manual: Disperser, Riot Control Agent, Portable, M3.
TM 3–1040–220–12	Operator and Organizational Maintenance Manual: Disperser, Riot Control Agent, Helicopter- or Vehicle-Mounted, M5.
TM 3–1040–254–13	Operator, Organizational, and DS Maintenance Manual: Disperser, Riot Control Agent, Portable, 450 CFM, M106.
TM 3–1310–243–10	Operator's Manual: Cartridge, 40mm, Tactical CS, XM651E1.
TM 3–1310–244–10	Operator's Manual: Cartridge 40mm, Riot Control CS, XM674, and Cartridge, 40mm: Red Smoke RS, XM675.
TM 3–1325–230–12	Organizational Maintenance Manual: Canister Cluster, Tactical CS, 130-lb, E159.
TM 3–1325–232–12	Operator and Organizational Maintenance Manual: Canister Cluster, Tactical CS, 50-lb, E158R2.
TM 3–1325–237–10	Fuze and Burster Bomb: System XM925.
TM 3–1330–204–10	Operator's Manual: Grenade, Hand: Riot, Pocket, CS, XM58.
TM 9–1330–200	Grenades, Hand and Rifle.
TB 3–1310–255–10	Launcher and 35mm Cartridges: Tactical CS, 16-Tube, E8.

APPENDIX B

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630

Use of the Tables

a. Data in tables in appendix B were based on a neutral atmospheric stability and windspeeds of about .7, 2, and 7 knots. Tactical assumptions were converged sheaf fire pattern, unmasked target population, and the arrival of all rounds in a given volley in one minute.

b. Effects for observed fire are shown in tables B–1 through B–3, B–7 through B–9, and B–13 through B–16. Effects for unobserved fire are shown in tables B–4 through B–6, B–10 through B–12, and B–17 through B–20. Data for unobserved fire are based on a target acquisition error (circular error probable) of 38 meters. When cloud coverage and effectiveness can be observed, the number of rounds to be fired can be controlled by the observer.

c. To apply the figures in the tables to actual tactical situations, assume 20 percent of the unmasked casualty value for populations masked with improvised masks. For attacks on inundated areas, assume 30 percent of the tabulated value, if the canisters are ignited when they enter the water. No significant reduction in effectiveness has been noted for canisters functioning in mud, even with as much as three-fourths of the canister buried and one emission port submerged.

TABLE B-1

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
1,000-Meter Range, 0- to 80-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.10	.21	.32	.60	.76
	2	.21	.43	.60		
	3	.32	.60	.76		
	4	.43	.72			
2	1	.15	.31	.46	.71	.81
	2	.31	.56	.71		
	3	.46	.71	.81		
	4	.56	.78			
7	1	.25	.47	.62	.79	.85
	2	.47	.69	.79		
	3	.62	.79	.85		
	4	.69	.84			

TABLE B-2

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
1,000-Meter Range, 100-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.07	.14	.23	.44	.59
	2	.14	.31	.44		
	3	.23	.44	.59		
	4	.31	.55			
2	1	.11	.24	.38	.68	.81
	2	.24	.48	.68		
	3	.38	.68	.81		
	4	.48	.78			
7	1	.21	.43	.62	.79	.85
	2	.43	.69	.79		
	3	.62	.79	.85		
	4	.69	.84			

TABLE B-3

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
1,000-Meter Range, 150-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.06	.10	.20	.26
	2	.06	.14	.20		
	3	.10	.20	.26		
	4	.14	.24			
2	1	.05	.10	.17	.30	.37
	2	.10	.22	.30		
	3	.17	.30	.37		
	4	.22	.35			
7	1	.09	.19	.28	.44	.54
	2	.19	.34	.44		
	3	.28	.44	.54		
	4	.34	.51			

TABLE B-4

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
1,000-Meter Range, 50-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.08	.18	.28	.54	.70
	2	.18	.39	.54		
	3	.28	.54	.70		
	4	.39	.64			
2	1	.14	.28	.43	.67	.77
	2	.28	.52	.67		
	3	.43	.67	.77		
	4	.52	.74			
7	1	.23	.44	.59	.77	.84
	2	.44	.65	.77		
	3	.59	.77	.84		
	4	.65	.82			

TABLE B-5

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
1,000-Meter Range, 100-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.06	.12	.18	.35	.46
	2	.12	.25	.35		
	3	.18	.35	.46		
	4	.25	.42			
2	1	.09	.18	.29	.49	.58
	2	.18	.36	.49		
	3	.29	.49	.58		
	4	.36	.55			
7	1	.16	.32	.44	.63	.73
	2	.32	.51	.63		
	3	.44	.63	.73		
	4	.51	.70			

TABLE B-6

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
1,000-Meter Range, 150-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.06	.10	.19	.26
	2	.06	.13	.19		
	3	.10	.19	.26		
	4	.13	.24			
2	1	.05	.10	.17	.30	.37
	2	.10	.21	.30		
	3	.17	.30	.37		
	4	.21	.34			
7	1	.09	.19	.28	.42	.50
	2	.19	.33	.42		
	3	.28	.42	.50		
	4	.33	.47			

TABLE B-7

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
3,000-Meter Range, 0- to 100-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.05	.10	.16	.33	.49
	2	.10	.21	.33		
	3	.16	.33	.49		
	4	.21	.43			
2	1	.07	.16	.24	.50	.69
	2	.16	.33	.50		
	3	.24	.50	.69		
	4	.33	.64			
7	1	.13	.27	.40	.67	.78
	2	.27	.51	.67		
	3	.40	.67	.78		
	4	.51	.76			

TABLE B-8

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
3,000-Meter Range, 150-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.06	.12	.20	.31
	2	.06	.13	.20		
	3	.12	.20	.31		
	4	.13	.27			
2	1	.04	.10	.16	.35	.50
	2	.10	.22	.35		
	3	.16	.35	.50		
	4	.22	.46			
7	1	.09	.19	.30	.58	.73
	2	.19	.40	.58		
	3	.30	.58	.73		
	4	.40	.68			

TABLE B-9

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
3,000-Meter Range, 200-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.03	.05	.11	.18
	2	.03	.07	.11		
	3	.05	.11	.18		
	4	.07	.15			
2	1	.02	.05	.09	.20	.28
	2	.05	.12	.20		
	3	.09	.20	.28		
	4	.12	.26			
7	1	.05	.09	.17	.32	.41
	2	.09	.23	.32		
	3	.17	.32	.41		
	4	.23	.38			

TABLE B-10

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
3,000-Meter Range, 100-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.04	.08	.13	.28	.42
	2	.08	.17	.28		
	3	.13	.28	.42		
	4	.17	.36			
2	1	.06	.13	.21	.43	.61
	2	.13	.28	.43		
	3	.21	.43	.61		
	4	.28	.56			
7	1	.11	.24	.36	.62	.74
	2	.24	.46	.62		
	3	.36	.62	.74		
	4	.46	.71			

TABLE B-11

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
3,000-Meter Range, 150-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.06	.09	.18	.28
	2	.06	.12	.18		
	3	.09	.18	.28		
	4	.12	.24			
2	1	.04	.09	.14	.30	.43
	2	.09	.19	.30		
	3	.14	.30	.43		
	4	.19	.40			
7	1	.08	.17	.26	.47	.59
	2	.17	.34	.47		
	3	.26	.47	.59		
	4	.34	.55			

TABLE B-12

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
3,000-Meter Range, 200-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.03	.05	.11	.18
	2	.03	.07	.11		
	3	.05	.11	.18		
	4	.07	.15			
2	1	.03	.05	.09	.19	.28
	2	.05	.12	.19		
	3	.09	.19	.28		
	4	.12	.25			
7	1	.05	.10	.17	.31	.40
	2	.10	.22	.31		
	3	.17	.31	.40		
	4	.22	.37			

TABLE B-13

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 0- to 140-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.06	.10	.20	.32
	2	.06	.14	.20		
	3	.10	.20	.32		
	4	.14	.28			
2	1	.05	.10	.16	.33	.51
	2	.10	.21	.33		
	3	.16	.33	.51		
	4	.21	.44			
7	1	.09	.18	.28	.55	.70
	2	.18	.37	.55		
	3	.28	.55	.70		
	4	.37	.66			

TABLE B-14

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 150-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.06	.09	.19	.30
	2	.06	.13	.19		
	3	.09	.19	.30		
	4	.13	.27			
2	1	.05	.09	.15	.33	.51
	2	.09	.20	.33		
	3	.15	.33	.51		
	4	.20	.45			
7	1	.08	.18	.28	.55	.70
	2	.18	.37	.55		
	3	.28	.55	.70		
	4	.37	.66			

TABLE B-15

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 200-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.03	.05	.11	.17
	2	.03	.08	.11		
	3	.05	.11	.17		
	4	.08	.15			
2	1	.03	.05	.08	.19	.30
	2	.05	.11	.19		
	3	.08	.19	.30		
	4	.11	.26			
7	1	.05	.10	.16	.36	.50
	2	.10	.23	.36		
	3	.16	.36	.50		
	4	.23	.46			

TABLE B-16

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 250-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.02	.03	.07	.11
	2	.02	.05	.07		
	3	.03	.07	.11		
	4	.05	.10			
2	1	.02	.03	.05	.12	.19
	2	.03	.07	.12		
	3	.05	.12	.19		
	4	.07	.16			
7	1	.03	.06	.11	.23	.32
	2	.06	.14	.23		
	3	.11	.23	.32		
	4	.14	.29			

TABLE B-17

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 100-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.06	.09	.18	.29
	2	.06	.13	.18		
	3	.09	.18	.29		
	4	.13	.26			
2	1	.04	.09	.14	.30	.47
	2	.09	.19	.30		
	3	.14	.30	.47		
	4	.19	.41			
7	1	.08	.16	.26	.52	.67
	2	.16	.35	.52		
	3	.26	.52	.67		
	4	.35	.63			

TABLE B-18

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 150-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
7	1	.02	.05	.07	.14	.23
	2	.05	.10	.14		
	3	.07	.14	.23		
	4	.10	.20			
2	1	.03	.07	.11	.24	.38
	2	.07	.15	.24		
	3	.11	.24	.38		
	4	.15	.33			
7	1	.06	.13	.21	.44	.58
	2	.13	.28	.44		
	3	.21	.44	.58		
	4	.28	.54			

TABLE B- 19

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 200-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.03	.05	.10	.16
	2	.03	.07	.10		
	3	.05	.10	.16		
	4	.07	.14			
2	1	.02	.05	.08	.17	.28
	2	.05	.11	.17		
	3	.08	.17	.28		
	4	.11	.24			
7	1	.04	.09	.15	.32	.44
	2	.09	.21	.32		
	3	.15	.32	.44		
	4	.21	.41			

TABLE B-20

TARGET COVERAGE FOR 4.2-INCH CS CARTRIDGE, XM630
For
5,000-Meter Range, 250-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		4	8	12	24	36
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.02	.03	.07	.11
	2	.02	.05	.07		
	3	.03	.07	.11		
	4	.05	.10			
2	1	.02	.03	.05	.12	.19
	2	.03	.07	.12		
	3	.05	.12	.19		
	4	.07	.16			
7	1	.03	.06	.10	.22	.31
	2	.06	.14	.22		
	3	.10	.22	.31		
	4	.14	.29			

APPENDIX C

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM 629

Use of the Tables

a. Data in tables in appendix C were based on a neutral atmospheric stability and windspeeds of about .7, 2, and 7 knots. Tactical assumptions were converged sheaf fire pattern, unmasked target population, and the arrival of all rounds in a given volley in one minute.

b. Effects for observed fire are shown in tables C–1 through C–5, C–11 through C–15, and C–21 through C–24. Effects for unobserved fire are shown in tables C–6 through C–10, C–16 through C–20, and C–25 through C–29. Data for unobserved fire are based on a target acquisition error (circular error probable) of 38 meters. When cloud coverage and effectiveness can be observed, the number of volleys to be fired can be controlled by the observer.

c. To apply the figures in the tables to actual tactical situations, assume 20 percent of the unmasked casualty value for populations masked with unsophisticated masks. For attacks on inundated areas, assume 30 percent of the tabulated value, if the canisters are ignited when they enter the water. No significant reduction in effectiveness has been noted for canisters functioning in mud, even with as much as three-fourths of the canister buried and one emission port submerged.

TABLE C- 1

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 0- to 70-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.20	.40	.57	.79	.84
	2	.40	.66	.79		
	3	.57	.79	.84		
	4	.66	.83			
2	1	.28	.53	.68	.84	.89
	2	.53	.75	.84		
	3	.68	.84	.89		
	4	.75	.88			
7	1	.43	.67	.77	.86	.90
	2	.67	.80	.86		
	3	.77	.86	.90		
	4	.80	.89			

TABLE C- 2

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 100-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.09	.20	.29	.43	.49
	2	.20	.35	.43		
	3	.29	.43	.49		
	4	.35	.47			
2	1	.15	.31	.44	.64	.72
	2	.31	.52	.64		
	3	.44	.64	.72		
	4	.52	.69			
7	1	.27	.51	.65	.86	.90
	2	.51	.76	.86		
	3	.65	.86	.90		
	4	.76	.89			

TABLE C- 3

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 150-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.04	.09	.13	.19	.22
	2	.09	.16	.19		
	3	.13	.19	.22		
	4	.16	.21			
2	1	.07	.14	.19	.28	.32
	2	.14	.23	.28		
	3	.19	.28	.32		
	4	.23	.31			
7	1	.12	.22	.29	.41	.47
	2	.22	.34	.41		
	3	.29	.41	.47		
	4	.34	.45			

TABLE C-4

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 200-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.05	.07	.11	.12
	2	.05	.09	.11		
	3	.07	.11	.12		
	4	.09	.12			
2	1	.04	.08	.11	.16	.18
	2	.08	.13	.16		
	3	.11	.16	.18		
	4	.13	.17			
7	1	.07	.13	.16	.23	.27
	2	.13	.19	.23		
	3	.16	.23	.27		
	4	.19	.26			

TABLE C-5

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 250-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.03	.05	.07	.08
	2	.03	.06	.07		
	3	.05	.07	.08		
	4	.06	.08			
2	1	.02	.05	.07	.10	.12
	2	.05	.08	.10		
	3	.07	.10	.12		
	4	.08	.11			
7	1	.04	.08	.10	.15	.17
	2	.08	.12	.15		
	3	.10	.15	.17		
	4	.12	.16			

TABLE C-6

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 50-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
7	1	.14	.30	.44	.63	.68
	2	.30	.52	.63		
	3	.44	.63	.68		
	4	.52	.66			
2	1	.22	.43	.57	.74	.80
	2	.43	.64	.74		
	3	.57	.74			
	4	.64	.78			
7	1	.35	.59	.70	.82	.86
	2	.59	.75	.82		
	3	.70	.82	.86		
	4	.75	.85			

TABLE C-7

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 100-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.08	.18	.26	.38	.42
	2	.18	.31	.38		
	3	.26	.38	.42		
	4	.31	.41			
2	1	.14	.29	.38	.51	.54
	2	.29	.44	.51		
	3	.38	.51	.54		
	4	.44	.53			
7	1	.24	.40	.48	.58	.61
	2	.40	.52	.58		
	3	.48	.58	.61		
	4	.52	.60			

TABLE C-8

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 150-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.04	.09	.12	.19	.21
	2	.09	.15	.19		
	3	.12	.19	.21		
	4	.15	.20			
2	1	.06	.13	.19	.28	.31
	2	.13	.23	.28		
	3	.19	.28	.31		
	4	.23	.30			
7	1	.12	.22	.28	.39	.46
	2	.22	.32	.39		
	3	.28	.39	.46		
	4	.32	.45			

TABLE C-9

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 200-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.05	.07	.11	.12
	2	.05	.09	.11		
	3	.07	.11	.12		
	4	.09	.12			
2	1	.04	.08	.11	.16	.18
	2	.08	.13	.16		
	3	.11	.16	.18		
	4	.13	.17			
7	1	.07	.13	.16	.21	.23
	2	.13	.18	.21		
	3	.16	.21	.23		
	4	.18	.23			

TABLE C-10

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
3,000-Meter Range, 250-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.03	.05	.07	.08
	2	.03	.05	.07		
	3	.05	.07	.08		
	4	.05	.07			
2	1	.02	.05	.07	.10	.12
	2	.05	.08	.10		
	3	.07	.10	.12		
	4	.08	.11			
7	1	.04	.08	.11	.15	.17
	2	.08	.12	.15		
	3	.11	.15	.17		
	4	.12	.16			

TABLE C-11

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 0- to 80-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.13	.28	.43	.71	.82
	2	.28	.54	.71		
	3	.43	.71	.82		
	4	.54	.80			
2	1	.20	.41	.58	.78	.87
	2	.41	.68	.78		
	3	.58	.78	.87		
	4	.68	.85			
7	1	.33	.58	.70	.85	.88
	2	.58	.76	.85		
	3	.70	.85	.88		
	4	.76	.88			

TABLE C-12

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 100-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.09	.19	.30	.53	.65
	2	.19	.39	.53		
	3	.30	.53	.65		
	4	.39	.62			
2	1	.14	.31	.48	.77	.87
	2	.31	.60	.77		
	3	.48	.77	.87		
	4	.60	.85			
7	1	.27	.56	.70	.85	.88
	2	.56	.76	.85		
	3	.70	.85	.88		
	4	.76	.88			

TABLE C-13

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 150-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.04	.09	.13	.24	.29
	2	.09	.17	.24		
	3	.13	.24	.29		
	4	.17	.27			
2	1	.06	.14	.21	.34	.40
	2	.14	.27	.34		
	3	.21	.34	.40		
	4	.27	.39			
7	1	.12	.25	.34	.48	.56
	2	.25	.39	.48		
	3	.34	.48	.56		
	4	.39	.54			

TABLE C-14

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 200-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.05	.07	.14	.16
	2	.05	.10	.14		
	3	.07	.14	.16		
	4	.10	.15			
2	1	.04	.08	.12	.19	.23
	2	.08	.15	.19		
	3	.12	.19	.23		
	4	.15	.22			
7	1	.07	.14	.19	.27	.32
	2	.14	.22	.27		
	3	.19	.27	.32		
	4	.22	.30			

TABLE C-15

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 250-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.03	.05	.09	.10
	2	.03	.06	.09		
	3	.05	.09	.10		
	4	.06	.10			
2	1	.02	.05	.08	.12	.14
	2	.05	.10	.12		
	3	.08	.12	.14		
	4	.10	.14			
7	1	.04	.09	.12	.17	.20
	2	.09	.14	.17		
	3	.12	.17	.20		
	4	.14	.20			

TABLE C-16

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 50-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.10	.21	.33	.56	.67
	2	.21	.43	.56		
	3	.33	.56	.67		
	4	.43	.64			
2	1	.16	.33	.48	.68	.78
	2	.33	.58	.68		
	3	.48	.68	.78		
	4	.58	.76			
7	1	.27	.50	.63	.79	.85
	2	.50	.70	.79		
	3	.63	.79	.85		
	4	.70	.83			

TABLE C-17

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 100-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.07	.14	.22	.39	.46
	2	.14	.29	.39		
	3	.22	.39	.46		
	4	.29	.45			
2	1	.10	.23	.33	.51	.58
	2	.23	.41	.51		
	3	.33	.51	.58		
	4	.41	.56			
7	1	.19	.37	.47	.61	.68
	2	.37	.53	.61		
	3	.47	.61	.68		
	4	.53	.67			

TABLE C-18

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 150-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.04	.08	.13	.24	.29
	2	.08	.17	.24		
	3	.13	.24	.29		
	4	.17	.27			
2	1	.06	.14	.21	.32	.37
	2	.14	.26	.32		
	3	.21	.32	.37		
	4	.26	.36			
7	1	.12	.23	.31	.41	.48
	2	.23	.34	.41		
	3	.31	.41	.48		
	4	.34	.46			

TABLE C-19

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 200-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.05	.07	.13	.16
	2	.05	.10	.13		
	3	.07	.13	.16		
	4	.10	.15			
2	1	.04	.08	.12	.19	.23
	2	.08	.15	.19		
	3	.12	.19	.23		
	4	.15	.21			
7	1	.07	.14	.19	.26	.31
	2	.14	.21	.26		
	3	.19	.26	.31		
	4	.21	.30			

TABLE C-20

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
5,000-Meter Range, 250-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.03	.05	.08	.10
	2	.03	.06	.08		
	3	.05	.08	.10		
	4	.06	.10			
2	1	.02	.05	.08	.12	.14
	2	.05	.10	.12		
	3	.08	.12	.14		
	4	.10	.14			
7	1	.05	.09	.12	.17	.20
	2	.09	.14	.17		
	3	.12	.17	.20		
	4	.14	.19			

TABLE C-21

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 0- to 100-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.08	.16	.25	.53	.69
	2	.16	.35	.53		
	3	.25	.53	.69		
	4	.35	.65			
2	1	.12	.25	.39	.69	.80
	2	.25	.50	.69		
	3	.39	.69	.80		
	4	.50	.78			
7	1	.21	.42	.59	.79	.86
	2	.42	.67	.79		
	3	.59	.79	.86		
	4	.67	.84			

TABLE C-22

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 150-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.04	.08	.13	.27	.36
	2	.08	.18	.27		
	3	.13	.27	.36		
	4	.18	.34			
2	1	.06	.13	.22	.41	.52
	2	.13	.28	.41		
	3	.22	.41	.52		
	4	.28 24 Rds	.50			
7	1	.12	.25	.38	.61	.72
	2	.25	.46	.61		
	3	.38	.61			
	4	.46	.69			

TABLE C-23

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 200-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.05	.07	.15	.20
	2	.05	.10	.15		
	3	.07	.15	.20		
	4	.10	.19			
2	1	.03	.07	.12	.23	.29
	2	.07	.16	.23		
	3	.12	.23	.29		
	4	.16	.28			
7	1	.07	.14	.22	.34	.41
	2	.14	.26	.34		
	3	.22	.34	.41		
	4	.26	.39			

TABLE C- 24

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 250-Meter Target Radius, Observed Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.03	.05	.10	.13
	2	.03	.06	.10		
	3	.05	.10	.13		
	4	.06	.12			
2	1	.02	.05	.08	.15	.19
	2	.05	.10	.15		
	3	.08	.15	.19		
	4	.10	.18			
7	1	.04	.09	.14	.22	.26
	2	.09	.16	.22		
	3	.14	.22	.26		
	4	.16	.25			

TABLE C-25

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 50-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.06	.13	.20	.42	.55
	2	.13	.28	.42		
	3	.20	.42	.55		
	4	.28	.53			
2	1	.09	.20	.32	.58	.70
	2	.20	.41	.58		
	3	.32	.58	.70		
	4	.41	.68			
7	1	.17	.36	.52	.72	.80
	2	.36	.60	.72		
	3	.52	.72			
	4	.60	.78			

TABLE C-26

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 100-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.04	.09	.15	.31	.41
	2	.09	.20	.31		
	3	.15	.31	.41		
	4	.20	.39			
2	1	.07	.15	.24	.46	.56
	2	.15	.32	.46		
	3	.24	.46	.56		
	4	.32	.54			
7	1	.13	.28	.41	.60	.68
	2	.28	.48	.60		
	3	.41	.60	.68		
	4	.48	.65			

TABLE C-27

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 150-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.03	.07	.11	.23	.30
	2	.07	.15	.23		
	3	.11	.23	.30		
	4	.15	.29			
2	1	.05	.11	.18	.33	.41
	2	.11	.24	.33		
	3	.18	.33	.41		
	4	.24	.39			
7	1	.10	.20	.30	.46	.52
	2	.20	.36	.46		
	3	.30	.46	.52		
	4	.36	.50			

TABLE C-28

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 200-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.02	.04	.07	.15	.20
	2	.04	.10	.15		
	3	.07	.15	.20		
	4	.10	.19			
2	1	.03	.07	.12	.22	.28
	2	.07	.15	.22		
	3	.12	.22	.28		
	4	.15	.27			
7	1	.06	.14	.21	.31	.37
	2	.14	.25	.31		
	3	.21	.31	.37		
	4	.25	.35			

TABLE C- 29

TARGET COVERAGE FOR 105MM CS CARTRIDGE, XM629
For
7,000-Meter Range, 250-Meter Target Radius, Unobserved Fire

WINDSPEED (knots)	NUMBER OF VOLLEYS	NUMBER OF TUBES				
		6	12	18	36	54
		FRACTION OF TARGET AREA COVERED				
.7	1	.01	.03	.05	.10	.13
	2	.03	.06	.10		
	3	.05	.10	.13		
	4	.06	.12			
2	1	.02	.05	.08	.15	.18
	2	.05	.10	.15		
	3	.08	.15	.18		
	4	.10	.18			
7	1	.04	.09	.14	.20	.25
	2	.09	.16	.20		
	3	.14	.20	.25		
	4	.16	.23			

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

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